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INCIDENCE OF DEFECTS IN VISUAL FUNCTION IN CHILDREN AND ADULTS

BY

ARNOLD SORSBY, B. BENJAMIN, AND JOHN YUDKIN

London

Examination of the eyes in the course of routine inspections in the School Medical Service is generally confined to establishing the presence of any obvious external eye disease, squint, and subnormal visual acuity. In different school returns some 20 to 30 per cent. of children are found to have defective visual acuity on school-leaving age, and the correction of refractive errors is, in fact, the largest aspect of the care of the eyes provided by the School Medical Service. That a certain number of boys, probably as much as 8 per cent., have some colour defect has been established by many special studies. The fact that some 1·5 per cent. of children show manifest squint raises the possibility that many more suffer from minor muscle imbalance. Since defects in colour vision and muscle balance exclude adults from certain specified occupations, and may constitute a serious handicap in others where no definite standards are laid down, it seems worth while to determine the extent of anomalies in visual function other than central visual acuity. Two parallel investigations have been undertaken, one in children at school-leaving age and the other in adults working as engineers in the Post Office.

The investigation on school children was carried out at West Ham during the years 1948–49; in all 654 children aged 12 to 14 years were examined. The investigation at the Post Office, made during 1950, concerned 501 men aged 21 to 40 years, and was carried out at the Personnel Department of the Post Office. This is not altogether a random sample of adult men, for certain visual standards—not very exacting—have to be satisfied by candidates for admission to the Post Office Service. Both series were re-investigated in 1953 to assess efficiency at work against the ocular findings.

Functions Tested and Methods Used

Visual acuity with and without glasses was taken in all cases; where glasses were needed these were worn in assessing the following functions: accommodation, convergence, muscle balance, binocular vision, colour vision, and dark adaptation. In children haemoglobin readings were carried out in addition, since both dark adaptation and haemoglobin may be affected by nutrition. The methods employed are given in Appendix I.

Findings in School Children

Basic Data.—These are summarized in Table I.

(*a*) *Visual Acuity without Glasses.*—Some 29 per cent. of children showed visual acuity of less than

Table I

INCIDENCE OF ANOMALIES RELATED TO VISUAL ACUITY IN CHILDREN

Function			Criteria of Normality	Unaided Visual Acuity (assessed by the worse eye)							
				6/4–6/6 (462 cases)		6/9–6/18 (102 cases)		6/24 or worse (90 cases)		Total (654 cases)	
				No.	%	No.	%	No.	%	No.	%
Convergence			5·0–8·5 cm.	456	5·7	100	14·0	81	9·9	637	7·5
Accommodation			12 cm. or less	457	6·1	102	16·7	78	16·7	637	9·1
Heterophoria	Vertical	Near	0–± ½Δ	448	2·5	97	5·2	79	10·1	624	3·8
		Distance	0–± ½Δ	447	2·0	95	10·5	80	7·5	622	4·0
	Lateral	Near	0–± 4 D.	448	5·1	97	19·6	79	20·3	624	9·3
		Distance	0–± 4 D.	446	2·5	95	14·7	79	7·6	620	5·0
Binocular Vision			Any grade of stereoscopic vision	457	1·1	102	2·0	87	14·9	646	3·1
Colour Vision			Normal to the Ishihara test	455	10·8	101	11·9	86	10·5	642	10·9
Dark Adaptation			2·5–3·1 log. $\mu\mu$l.	453	4·0	98	9·2	84	11·9	635	5·8
Haemoglobin			At least 12 g. per ml.	453	3·5	100	4·0	88	1·1	641	3·3

6/6 in one or both eyes. The separate distributions for age and sex did not differ significantly from the distribution of the group as a whole, nor was there any significant difference between right and left eyes. If visual acuity was good in one eye it was generally also good in the other—the correlation between right and left (on scaling 6/24 as 0·25, 6/18 as 0·33 etc.) is + 0·83.

(*b*) *Accommodation.*—There were no significant differences with age or sex. Each eye was tested separately and there was close agreement between right and left eyes in individual children. Some 74 per cent. were able to accommodate at 9 to 11 cm., and an additional 8 per cent. at an even closer range.

(*c*) *Convergence.*—There were no significant differences with age or sex. Some 52 per cent. of children could converge to a distance of 5·5 cm., and relatively few were unable to converge to a distance less than 9 cm.

(*d*) *Muscle Balance.*—The incidence of heterophoria was determined for both near and distance and for lateral and vertical balance. Orthophoria was found to be not as exceptional as is generally believed. In fact, both for near and for distance the values for orthophoria were the highest observed: 46 and 66 per cent. respectively. Marked degrees of heterophoria were uncommon. Assessment of vertical imbalance gave the expected high incidence of orthophoria: 96 per cent. for both near and distance. No age or sex variations were seen in lateral or vertical imbalances. There was a statistically significant (though not strong) association between near and distance readings: vertical $r = + 0{\cdot}35$, lateral $r = + 0{\cdot}46$. The measurements for lateral distance balance were made separately for right and left eyes. The co-efficient of correlation between the measurement of the two eyes was very high, +0·89.

(*e*) *Binocular Vision.*—No variations were seen with age or sex; only 3·1 per cent. of children had no stereoscopic vision. The degree of stereoscopic vision was determined in 425 children; of these only 77 were found to have stereoscopic vision less than Grade 5 on the Livingston scale.

(*f*) *Colour Vision.*—No age variation of any statistical significance was observed, but the usual sex difference was found: some 85 per cent. of boys and 94 per cent. of girls were normal. (Amongst boys red defect was present in 2 per cent., green defect in 5·5 per cent. and anomalous colour vision was seen in 7·8 per cent.; the corresponding percentages for girls were 0·0, 0·7, and 5·0).

(*g*) *Dark Adaptation.*—No age or sex variation was seen. Most children gave readings between 2·7 and 3·1 log $\mu\mu$l. on the Crookes adaptometer. Readings lower than 2·7 were observed in 2·2 per cent. of cases, and readings higher than 3·1 in 5·8 per cent.

(*h*) *Haemoglobin.*—As an adjunct to readings for dark adaptation haemoglobin determinations were carried out. There were no significant age and sex variations. The distribution was mainly within the range of 11 to 16 g. per cent., the peak being between 13 and 14 g. per 100 mm. There was considerable variation, the coefficient of variation being 8·3 per cent.

CRITERIA OF NORMALITY.—These are shown in Table I against each function. They were assessed on clinical grounds and generally agreed with those derived from inspection of the curves of distribution of the actual findings, except that the assumed standard of normality was perhaps rather too strict for accommodation and for dark adaptation, and perhaps too lenient for convergence. Visual acuity was regarded as normal if the unaided vision in each eye was 6/6 or better.

INCIDENCE OF DEFECTS.—As Table I shows, each function tested separately gave a proportion of defectives. The data were not quite complete in all cases and the incidence of defect—by the arbitrary criteria employed here—varied with different functions.

The incidence of anomalies of the different visual functions is inconsiderable in children with normal visual acuity, and considerably higher in those whose unaided vision is less than normal in one or both eyes. A striking but expected exception is the incidence of colour vision. Correction for visual acuity does not apparently compensate the excess of defects in those with initially subnormal vision, for the tests were carried out with correcting glasses when worn, and only exceptionally did these give vision of less than 6/6 in each eye.

PROPORTION OF NORMAL CHILDREN.—Confining attention to the 553 cases out of the 654 in which records were available for all the functions, Table II (opposite) shows that about 75 per cent. of all cases have normal visual acuity, and that only about 70 per cent. of these are normal when other visual tests are also considered. If all visual functions are considered only some 52 per cent. of the school population are normal.

It may also be noted that of the 139 children with visual acuity below normal, some 47 per cent. were normal in every other visual function.

TABLE II
CHILDREN NORMAL ON SCREENING TESTS

Visual Acuity		Normal (414 children)		Subnormal (139 children)	
		No.	%	No.	%
Functions	1	389	94·0	125	89·9
	1 2	365	88·2	103	74·1
	1 2 3	356	86·0	96	69·1
	1 2 3 4	351	84·8	93	66·9
	1 2 3 4 5	337	81·4	80	57·6
	1 2 3 4 5 6	333	80·4	79	56·8
	1 2 3 4 5 6 7	328	79·2	79	56·8
	1 2 3 4 5 6 7 8	298	72·0	70	50·4
	1 2 3 4 5 6 7 8 9	288	69·6	65	46·8

Key to Functions
1. Convergence.
2. Accommodation.
3. Heterophoria, vertical near.
4. Heterophoria, vertical distance.
5. Heterophoria, lateral near.
6. Heterophoria, lateral distance.
7. Binocular vision.
8. Colour vision.
9. Dark adaptation.

GROSS FREQUENCY OF ANOMALIES.—It is known from Table II that in children with unaided normal visual acuity the chances are two to one that other functions will be normal too. Actually it is exceptional for a child with normal vision to have more than one abnormality, and no child in this group had more than three anomalies.

Amongst those whose visual acuity was subnormal without glasses the chances were even that other functions would be subnormal. The gross incidence of other defects was rather higher and more broadly distributed than in children with normal vision.

It may be noted that no child was abnormal in all the visual functions.

CORRELATIONS.—The inter-correlation between pairs of characteristics was tested. No strong associations were found but some statistically significant though weak associations are shown in Table III.

TABLE III
STATISTICALLY SIGNIFICANT ASSOCIATIONS IN CHILDREN

Defects Associated				$P(\chi^2)$	Tschuprow's Coefficient
Visual Acuity and	Accommodation			<0·01	0·12
	Heterophoria	Vertical	Near	<0·01	0·14
			Distance	<0·01	0·15
		Lateral	Near	<0·01	0·28
			Distance	<0·01	0·17
	Binocular Vision			<0·01	0·21
	Dark Adaptation			<0·02	0·09
Convergence and Heterophoria, lateral near				<0·01	0·09

No statistically significant association was found between dark adaptation and haemoglobin levels. Dark adaptation was subnormal in 36 out of 602 children with normal haemoglobin levels and in one case out of 21 with subnormal levels (exact probability method of Fisher gave $p = 0·64$).

FINDINGS IN ADULT MEN

BASIC DATA.—These are summarized in Table IV.

(*a*) *Visual Acuity without Glasses.*—Four age groups were considered: 21–24, 25–30, 31–34, and 35–40 years. The four groups taken as a whole show visual acuity of 6/6 or more in the worse eye in some

TABLE IV
INCIDENCE OF ANOMALIES RELATED TO VISUAL ACUITY IN ADULTS

Function			Criteria of Normality	Unaided Visual Acuity (assessed by the worse eye)							
				6/4–6/6 (317 cases)		6/9–6/18 (98 cases)		6/24 or worse (85 cases)		Total (500 cases)	
				No.	%	No.	%	No.	%	No.	%
Convergence			5·0–12·0 cm.	317	6·3	95	15·8	83	10·8	495	8·9
Accommodation			17 cm. or less	317	11·0	98	16·3	85	5·9	500	11·2
Heterophoria	Vertical	Near	0–± ½Δ	317	5·0	97	8·2	82	20·7	496	8·3
		Distance	0–± ½Δ	316	12·7	97	16·5	83	22·9	496	15·1
	Lateral	Near	0–± 4 D	317	24·3	97	24·7	82	22·0	496	24·0
		Distance	0–± 4 D	316	9·8	97	13·4	84	16·7	497	11·7
Binocular Vision			Any grade of stereoscopic vision ..	317	2·5	98	6·1	84	10·7	499	4·6
Colour Vision			Normal to the Ishihara test	317	5·7	98	2·2	85	3·5	500	5·8
Dark Adaptation			2·5–3·2 log. $\mu\mu$l.	317	12·9	98	26·5	85	17·6	500	16·4

63 per cent. There was, however, a statistically significant variation with age, the incidence of full visual acuity being 68·6, 66·7, 56·5, and 54·2 per cent. in the four age groups. The correlation coefficient between right and left eye (scaling 6/24 as 0·25, 6/18 as 0·33, etc.) is +0·65.

(*b*) *Accommodation.*—The range of accommodation also varied with age. In the four groups aged between 21 and 40 years, ability to accommodate to 14 cm. or less was present in some 77 per cent., 72 per cent., 51 per cent., and 33 per cent. In the first age group (21–24 years) some 4 per cent. could not accommodate at 17 cm. or less, and in the three succeeding age groups this percentage rose to 8, 13, and 27 per cent.

(*c*) *Convergence.*—There was no significant difference between the different ages. The modal value was 5·5 cm. No individual could converge to less than that, and only 3·4 per cent. failed to converge to 14 cm.

(*d*) *Muscle Balance.*—The distribution for lateral balance showed no significant variations with age. Orthophoria itself was not common (about 20 per cent. for near, and about 27 per cent. for distance). If, however, values ranging from 0 to ±4△ are taken as normal, about 76 per cent. were normal for near, and 88 per cent. for distance. Vertical orthophoria was observed in 92 per cent. for near and in 85 per cent. for distance. No age variations were seen.

(*e*) *Binocular Vision.*—Here, too, no age variations were seen; about 95 per cent. showed stereoscopic vision, 80 per cent. giving readings between 5 and 10 on the Livingston scale.

(*f*) *Colour Vision.*—The incidence of colour defect was 5·8 per cent.

(*g*) *Dark Adaptation.*—There was a perceptible deterioration in adaptation with advancing age. At 21 to 24 years 12·3 per cent. showed a reading of 3·3 log $\mu\mu$l. or higher, and at 35 to 40 years the corresponding percentage was 26·1.

(*h*) *Haemoglobin.*—No examinations were made.

CRITERIA OF NORMALITY.—These are shown in Table IV against each function. As in the children they were assessed on clinical grounds and generally agreed with those derived from the distribution of the actual findings. With three functions—visual acuity, accommodation, and dark adaptation—capacity varied with age, but the criteria for normality shown in Table IV were those found for the group as a whole.

It will be noted that the same standards were used for adults as for children for visual acuity, muscle balance, binocular vision, and colour vision, and that lower standards for adults were employed for convergence, accommodation, and dark adaptation.

INCIDENCE OF DEFECTS.—The adults, like the children, showed a considerable incidence of defects in functions other than central visual acuity (Table IV).

The anomalies observed for the different categories of unaided visual acuity are also shown in Table IV. As in the children, the incidence of anomalies was almost consistently higher in those with defective visual acuity than in those with good vision.

PROPORTION OF NORMAL ADULTS.—Table V, covering 493 cases with complete records, shows that 316 men with normal visual acuity had a total incidence of 55·1 per cent. of other defects, so that the 64·1 per cent. of the total with normal vision was reduced to 28·8 per cent. with completely normal ocular functions. Only a little more than one quarter of adults were therefore normal by all the criteria used here. It may also be noted that of 177 adults with visual acuity below normal, 31·1 per cent. were normal in every other respect.

TABLE V

PROPORTION OF ADULTS NORMAL ON SCREENING TESTS

Visual Acuity		Normal (316 persons)		Subnormal (177 persons)	
		No.	%	No.	%
Functions	1	297	94·0	152	85·9
	1 2	264	83·5	142	80·2
	1 2 3	248	78·5	124	70·1
	1 2 3 4	225	71·2	110	62·1
	1 2 3 4 5	176	55·7	87	49·2
	1 2 3 4 5 6	167	52·8	83	46·9
	1 2 3 4 5 6 7	165	52·2	81	45·8
	1 2 3 4 5 6 7 8	159	50·3	77	43·5
	1 2 3 4 5 6 7 8 9	142	44·9	55	31·1

Key to Functions
1. Convergence.
2. Accommodation.
3. Heterophoria, vertical near.
4. Heterophoria, vertical distance.
5. Heterophoria, lateral near.
6. Heterophoria, lateral distance.
7. Binocular vision.
8. Colour vision.
9. Dark adaptation.

GROSS FREQUENCY OF ANOMALIES.—Amongst those with normal visual acuity nearly one-quarter had anomalies in two or more other visual functions. The corresponding proportion amongst those with abnormal visual acuity was nearly one-third.

CORRELATIONS.—The inter-correlation between pairs of characteristics was tested from Table IV and similar cross tabulations. No strong associations were found, but some statistically significant though weak associations are shown in Table VI (opposite).

TABLE VI
STATISTICALLY SIGNIFICANT ASSOCIATIONS IN ADULTS

Defects Associated		$P(\chi^2)$	Tschuprow's Coefficient
Visual Acuity and	Convergence	<0·01	0·14
	Heterophoria, vertical near	<0·01	0·17
	Binocular Vision ..	<0·01	0·14
	Dark Adaptation ..	<0·01	0·12
Convergence and Heterophoria, lateral near		<0·02	0·11

DISCUSSION

(1) COMPARISON OF INCIDENCE OF DEFECTS IN CHILDREN AND ADULTS.—Amongst the visual functions, binocular vision and colour vision are known to be uninfluenced by age, whilst all the others are affected, some markedly. The present study bears out that the capacity for binocular vision is not influenced by age; the distinctly lower incidence of colour anomaly recorded for adults as compared with children is readily explicable, since the Post Office personnel have to rely on colour sense to a considerable extent, and an element of self-selection appears to have come into play.* The incidence of defects in other visual functions shows a considerable increase in adults as compared with children, but only visual acuity without glasses, accommodation, and dark adaptation (all of which have been studied for the different age groups in men) show a significant progressive increase in the four adult age groups investigated. It may be noted that the comparison between children and adults was somewhat weighted in favour of the adults, for they had undergone some occupational selection, whereas only children with extreme anomalies who would be attending classes for the partially sighted had been left out.

Clinically, the progressive deterioration in visual acuity and accommodation with age is readily compensated by the use of lenses. The increase in the incidence of defects in convergence—even when allowance is made for a lower norm in adult men—is apparently due to the same mechanism as that which produces an increase in the incidence of defects of muscle balance, *i.e.* a failure of muscle action. The capacity for dark adaptation declines steadily with age, probably because of the decrease in size of the dark-adapted pupil. A practical application of these findings is that (excluding binocular vision and colour vision) the incidence of defects in visual functions increases steadily over the years. A child with normal visual functions may, therefore, still develop anomalies in later life; a child with anomalies is unlikely to improve. Not only the child who may become anomalous, but the child who is already anomalous, is missed in tests which are limited to the assessment of central visual acuity.

(2) THE FULLY NORMAL CHILD AND ADULT.—Some 70 per cent. of children have normal unaided visual acuity, but only about 50 per cent. of children are normal if all the different visual functions are considered, for about 30 per cent. of those who pass as normal on tests for visual acuity, fail to pass on the other tests. The proportion of adult men who are fully normal is considerably less than the proportion of children: only about 60 per cent. of adult men have normal unaided visual acuity, and well over half of these fail on the other tests, so that only about 30 per cent. of men are fully normal.

(3) THE ANOMALOUS CHILD

(*a*) *The Child with (Unaided) Normal Visual Acuity.*—On the available evidence, amongst 100 children with normal visual acuity, 31 would have some forty anomalies between them. Eleven would be anomalous on colour vision alone. The different varieties of muscle imbalance would contribute twelve anomalies, and these are essentially amenable to treatment; owing to the frequent association of one element of imbalance with another this means that eight out of the 31 children could be treated. The possibility of treating the remaining anomalies is indefinite; general measures might conceivably help with convergence, accommodation, and dark adaptation, but only exceptionally would remedial measures help the child (there would be only one in our hypothetical sample of 31 anomalous children) with no binocular vision. In broad terms there seems to be scope for therapeutic measures for about half of the 30 per cent. or so of children in whom normal visual acuity is associated with anomalies of other visual functions.

(*b*) *The Child with (Unaided) Subnormal Visual Acuity.*—The considerable incidence of defects in the different visual functions in these children shows how little can be expected from correcting glasses in reducing anomalies in visual functions other than visual acuity, which itself is readily corrected. The possibility of therapeutic measures seems to be greater here, as about half of these defects are contributed by errors in muscle balance. The clearly irremediable error due to colour anomalies only contributes about one-tenth of the total of defects, and affects one-fifth of the children with anomalies.

* One of the Post Office employees volunteered the statement that in joining up cables of different colours he gets a mate to check the colour, as he knows his own colour discrimination to be unreliable.

(4) THE ANOMALOUS ADULT

(*a*) *The Adult with* (*Unaided*) *Normal Visual Acuity.*—The frequency of anomalies in the different functions, taking them as a whole, is more than twice as high in adults as in children. The proportion of remediable and possibly remediable defects is higher in adults than in children, for anomalies in muscle balance—presumably remediable—preponderate.

(*b*) *The Adult with* (*Unaided*) *Subnormal Visual Acuity.*—As with children, there is a greater incidence of anomalies of the other visual functions. Again as with children, the excess is possibly remediable, since it is due to a higher incidence of errors of muscle balance.

(5) CLINICAL IMPLICATIONS.—The salient facts brought out by the present investigations are these:

(*i*) About 70 per cent. of children of school-leaving age have unaided normal visual acuity in the two eyes. Almost a third of these show anomalies in in the other visual functions. Anomalies in colour vision with their irremediable consequences constitute about a quarter of the defects. Lack of stereoscopic vision is uncommon, but anomalies in muscle balance, convergence, accommodation, and dark adaptation are not infrequent.

(*ii*) About 60 per cent. of adult men have unaided normal visual acuity, but the incidence of anomalies of other visual functions, excepting colour vision and binocular vision, is considerably higher than in children. (This higher incidence takes into account the normal physiological decrease in capacity for convergence, accommodation, and dark adaptation. For muscle balance the same criteria were used as for children).

The adult man who finds that his distance vision and his capacity for near work are failing, has ready recourse to glasses, which largely overcome these disabilities. He knows that colour defects are irremediable, and both by official action and by self-selection certain occupations are barred to such men. Decrease in the capacity for dark adaptation is only exceptionally sufficient to impose a definite handicap. It is with the heterophorias, poor convergence, and exceptionally with poor binocular vision, that real, though ill-recognized problems, may arise. The considerable increase in the incidence of the heterophorias with age presents a double clinical difficulty. The ophthalmologist has to assess firstly whether the heterophorias, as arbitrarily defined in the present study, produce symptoms, and secondly whether they are amenable to treatment.

(6) SIGNIFICANCE OF VISUAL DEFECTS UNDER FIELD CONDITIONS.—In 1953, some 5 years after the original survey, a follow-up of the children and adults previously examined was attempted. Adequate data could be obtained on 320 of the 654 children originally examined, and on 354 of the 501 men. Information was obtained on the children's progress after leaving school and this was set against the findings on their eyes. An assessment of the men's efficiency at their work was likewise set against their ocular record.

(*a*) *Follow-up of School Children.*—In the 5 years or so that had elapsed most of the children had entered industry, and towards the end of this period most of the boys had been drafted to the Services. It was thus possible to assess how their careers had shaped: some had obviously progressed in their work (having risen, for example, from junior clerkships to more responsible posts—Group 1), and many more had maintained their positions (staying as apprentices to compositors, continuing at technical schools, holding their own at office work or in a factory, and so on—Group 2). As against these two groups of children whose careers were essentially satisfactory, others had poorer records: some had shown little tendency to engage in any but menial or "blind-alley" occupations (Group 3), some had changed their occupation frequently (Group 4), and a few seemed to be drifting aimlessly (Group 5). These five groups and the ocular findings are shown in Table VII (opposite), which shows that a poor visual score is not a significantly adverse factor in the shaping of a career, but that other factors obviously have a more determining effect. It should, however, be noted that this assessment could not be made on the basis of specific visual requirements for specific tasks.

(*b*) *Follow-up of Post Office Engineers.*—Of the total of 354 men for whom follow-up information was available, thirteen were excluded from further consideration as they fell into two small occupational groups. The remaining 341 men were employed on three distinct types of work. The visual requirements of two groups were considered to be very much the same, whilst those of the third group were thought to be rather less stringent. The visual records of these workers were set against the rating each had obtained for efficiency at his work, as shown in Table VIII (opposite).

It will be seen that the group with only moderate efficiency showed a rather greater incidence of visual defects than was found in those with higher degrees of efficiency. The differences observed were not, however, large enough to be statistically significant;

TABLE VII

FOLLOW-UP ON CAREERS 5 YEARS AFTER LEAVING SCHOOL RELATED TO PREVIOUS OCULAR FINDINGS IN SCHOOL CHILDREN

Sex	Careers					
	Satisfactory (Groups 1 and 2)			Less Satisfactory (Groups 3, 4, and 5)		
	Percentage Visual Defects* at School		Total No. Children	Percentage Visual Defects* at School		Total No. Children
	One or Two Functions	Three or More Functions		One or Two Functions	Three or More Functions	
Male	29	7	126	21	13	47
Female	42	3	94	36	6	53
Total	35	5	220	29	9	100

* The same criteria were used as before, except that 6/9 vision was regarded as normal.

The total incidence of defects is about the same in both these groups. The excess of those with more than three defective functions in the less satisfactory group is not statistically significant.

TABLE VIII

FOLLOW-UP ON GRADING OF EFFICIENCY AT WORK 5 YEARS AFTER OCULAR SURVEY OF POST OFFICE ENGINEERS

Visual Requirements	Class of Work	Efficiency			
		Very Good and Good		Moderate	
		No. in Group	Percentage showing Defect in one or more required Visual Functions	No. in Group	Percentage showing Defect in one or more required Visual Functions
Good visual acuity[1] Stereoscopic vision[2] Normal colour vision[3]	(1) Auto and 2VF equipment maintenance VF Telegraph maintenance, general wiring duties, including jumpering	122	9	11	18
		} 251	} 8	} 35	} 14
Good visual acuity[1] Stereoscopic vision[2] Normal colour vision[3]	(2) Exchange maintenance Transmission equipment maintenance Power, stores, and workshop duties	129	8	24	13
Good visual acuity[1] Muscle balance[4]	(3) Test Desk Lining-up and Control duties Survey and Clerical work	50	16	5	40

[1] 6/6 or more in the better eye, corrected if necessary.
[2] 3 + 6 or more on the Livingston scale.
[3] On the Ishihara test.
[4] Anomaly allowed: $\frac{1}{2}\Delta$ hyperphoria and 6Δ of esophoria or exophoria.

These differences are not large enough to be statistically significant. Their consistency does, however, suggest that visual defects played some part in producing efficiency graded as only moderate.

their consistency suggests that they do play a part, though clearly there are other factors.

(7) SOME TENTATIVE CONCLUSIONS.—The findings justify the following observations:

(*i*) There is no case for extending the routine medical examination at school to cover visual functions other than central acuity.

(*ii*) There is a case for assessing specific visual functions for specific tasks.

(*iii*) The requirements of specific industries need to be established. Only a few have any clear criteria, though there is much to suggest that industrial efficiency and individual contentment call for such requirements to be clearly known.

(*iv*) An investigation into the possibilities of ameliorating visual defects other than those of central visual acuity in school children is warranted. Nothing can be done for congenital colour defect, or for children lacking binocular vision, but knowledge on other matters is needed. The practical significance of defective dark adaptation remains to be assessed. The nature and significance of anomalies of accommodation, convergence, and muscle balance are ill-understood. As these functions are all largely muscular in type and do not appear to be markedly correlated with visual acuity, there is a possibility

that they are determined by systemic rather than local factors, though an ocular factor is suggested by the greater incidence of such anomalies in children with unaided subnormal vision. The relative significance of systemic and ocular factors needs to be determined, as also whether anomalies of muscle action cause disabilities, and whether they are amenable to treatment. Information so gained in children should be invaluable in assessing the importance to be attached to the considerably greater incidence of such anomalies in the adult population.

Summary

(1) The different functions of vision—central visual acuity, accommodation, convergence, muscle balance, binocular vision, colour vision, and dark adaptation—were tested in 654 children aged 12 to 14 years, and in 501 men aged 21 to 40 years.

(2) Conventional criteria of normality were adopted; these were largely confirmed by the distribution curves obtained in this material.

(3) In children, 74·9 per cent. were found to have normal visual acuity, but only 52·1 per cent. were normal in all respects. In adults, 64·1 per cent. had normal visual acuity, and 28·8 per cent. were normal in all respects.

(4) In both children and adults the incidence of defects other than those of visual acuity was considerably higher in those whose central visual acuity was subnormal.

(5) Except for colour vision and stereoscopic vision, the incidence of anomalies was found to increase markedly with age. In consequence, whilst relatively few children showed more than one defect, the incidence of multiple defects in adults was considerable.

(6) There is some evidence that both systemic and local factors are responsible for anomalies other than those of central visual acuity, and for the increased incidence of some anomalies with age.

(7) The functional significance of the relatively unconsidered anomalies, especially those of muscle balance and stereoscopic vision, and whether these anomalies are remediable, remains to be assessed.

(8) A follow-up after 5 years of the school children examined offered no suggestion that anomalies in visual functions had significantly affected their careers, though owing to the large number of occupations involved it was not possible to relate this inquiry to specific occupations. A similar follow-up inquiry amongst the adults examined could be related to specific tasks; here it appeared that there might be some relationship between efficiency at work and the visual capacity required for particular tasks.

(9) The need for specific visual standards for different occupations is indicated.

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APPENDIX

Functions Tested and Methods Employed

CHILDREN

(1) Visual Acuity.—The standard Snellen test type was used at 6 m., illuminated by two 60-watt Tungsten lamps with reflectors placed 1 ft. from the board.

Each eye was tested separately and both eyes together with and without glasses. Visual acuity was recorded according to the lowest line of which all the letters were read correctly plus any letters correctly read in the next line. If more than half the letters were read correctly that line was taken as the measure of visual acuity for analysis.

Children without glasses and having less than 6/9 vision in one eye were refracted and tested for the other visual functions with glasses if prescribed. With correction it was exceptional for a child not to have full vision.

(2) Accommodation.—The Livingston binocular gauge was used and each eye was tested separately. The end-point was taken not at inability to read but at the onset of subjective blurring of type.

(3) Convergence.—The Livingston binocular gauge was used, taking as end-point the objective deviation of the corneal reflexes.

(4) MUSCLE BALANCE.—For near vision the Maddox wing was used and for distance the Maddox rod at 6 m. fixing with each eye in turn.

(5) BINOCULAR VISION.—This was assessed on the synoptophore using the following criteria:

Simultaneous Macular Perception.—Ability to superimpose large-sized simultaneous macular perception slides (Lion and Cage. Clement Clarke, H.11–12).

Fusion.—Ability to fuse large fusion slides (Rabbit with flowers and tail. Clement Clarke, F.3–4).

Stereoscopic Vision.—Eccentric rings (Clement Clarke, D.1–2) were used as the minimum requirement for stereoscopic vision. In addition 425 children out of the total were tested for degree of stereoscopic vision using the Livingston rotating stereogram slides in the synoptophore.

(6) COLOUR VISION.—The Ishihara pseudo-isochromatic plates, 6th edition (1932) were used. The illumination was designed to approach as closely as possible to the International Commission on Illumination's "illuminant C", recommended by Hardy (1945). This consisted of a lamp and blue glass filter giving an illumination of 50 foot-candles on the plates with an equivalent colour temperature of 7,500°K.

Dichromatism was diagnosed when the subject consistently gave the dichromatic reading for two or more of the Plates 2–5. The type of dichromatic defect was assessed in Plates 12 and 13; protanopes read Plate 12 as 6 and Plate 13 as 2, while deuteranopes read Plate 12 as 2 and Plate 13 as 4.

Anomalous trichromatism was diagnosed when the subject fell short of frank dichromatism and yet made at least one mistake in Plates 2–5 with each eye.

(7) DARK ADAPTATION.—This was measured with the Crookes's adaptometer by measuring the "final rod threshold", that is, the minimal amount of light detected after complete, or nearly complete, dark adaptation. At intervals of about 15 minutes, groups of three or four subjects entered a dark room directly from their work with no previous dark adaptation. After at least 35 minutes, each subject was placed at the instrument, the illumination increased and decreased and the value recorded at which the light just disappeared. This was repeated over a minute or two until consistent readings were obtained. The three or four subjects in each group were tested in turn and then tested a second time in the same order. The second value was taken as a measure of the subject's capacity for dark adaptation. The techniques employed were those given by Robertson and Yudkin (1944).

(8) HAEMOGLOBIN.—This was estimated by the alkaline haematin method. From the pricked fore-finger, 0·05 ml. blood was accurately taken and mixed into exactly 5 ml. 0·1 N caustic soda solution. The tubes containing the mixture were heated in a water bath and then the intensity of colour, referred to the Gibson-Harrison artificial standard solution, was measured in a photo-electric colorimeter (Clegg and King, 1942).

ADULTS

The methods of examination used in adults were the same as those for children, except that no haemoglobin tests were carried out.

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INCIDENCE, MORTALITY, AND SEX DISTRIBUTION OF MONGOLOID DEFECTIVES

BY

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The incidence of mongolism has been expressed in various ways. It was estimated among inmates of mental deficiency institutions by Shuttleworth (1909) and several of his contemporaries. Other workers, such as Bleyer (1932), calculated its incidence in patients attending paediatric clinics. Attempts have also been made to relate the number of living mongols to the total population (Doxiades and Portius, 1938; Böök and Reed, 1950). Since the mortality of mongols in infancy is probably high (Øster, 1953), such estimates are of limited value. Perhaps the most satisfactory data yet available are those derived from maternity hospitals. Øster (1953) collected from the literature eight hospital series which gave frequencies ranging from 0·5 to 3·4 per 1,000 births, but rejected the highest (Beidleman, 1945) and the lowest (Stevenson, Worcester, and Rice, 1950), which showed a remarkable discrepancy considering that they were derived from the same hospital. The incidence in the six remaining hospitals ranged from 1·1 to 2·1 (mean 1·7) per 1,000 births. To these may be added Øster's estimate of 0·84, and that of Carter and MacCarthy (1951) of 1·5 per 1,000. The last authors obtained their data from several hospitals, and noted that incidence was above average (2·1 and 1·6 per 1,000) in two hospitals where the staff were particularly interested in mongolism.

Cases selected from maternity hospitals may not, however, be sufficiently representative for investigation of mortality, or of certain aetiological features such as fertility. Unfortunately the difficulties in obtaining more satisfactory series are considerable. Ascertainment is incomplete among hospital births, and must be even less complete among domiciliary births, where the standard of diagnosis is inevitably lower. It is probable that many cases die unrecognized in early infancy; even if diagnosed, death may be ascribed to a more immediate cause and mention of mongolism may be omitted from the death certificate.

In view of these difficulties, a series derived from all births in a large community is almost certain to be incomplete and may not be free from bias. We considered, however, that it might be more useful for study than a series collected solely from hospital births.

Material

An attempt was made to collect all cases of mongolism born during the eleven years 1942 to 1952 to mothers normally resident in the City of Birmingham. The series was compiled from the following sources:

(*a*) Records of five maternity hospitals and three maternity units of general hospitals.
(*b*) Records of the Children's Hospital and the paediatric wards and out-patient records of other hospitals.
(*c*) Register of infant deaths maintained by the Maternity and Child Welfare section of the Public Health Department.
(*d*) Records of the Mental Health section of the Local Authority.
(*e*) A series of cases of congenital heart disease previously assembled (MacMahon, McKeown, and Record, 1953).

The total number of related births was ascertained from the Registrar General's Statistical Reviews for each of the eleven years under consideration. The number of hospital births was derived from records of the Maternity and Child Welfare Section of the City's Public Health Department. The total number of cases of mongolism recorded was 256, but four infants were later discovered to be unaffected, and were removed from the series. Information on survival was obtained by interrogation of the mother who was visited in her home. In 217 cases, the mothers were traced and co-operated in the investigation. Of the remainder, 32 had moved to unknown addresses, and three refused information.

Results

During the period, 252 mongols were identified in a population of 231,619 total births (1·09 per 1,000). The incidence of mongolism at birth has not previously been given for a large general

population, but from knowledge of incidence in maternity hospitals, and by correcting for differences in maternal age distribution, Carter and MacCarthy (1951) estimated the incidence in England and Wales as at least 1·60 per 1,000 maternities (equivalent to 1·58 per 1,000 births). It seems likely, therefore, that ascertainment in the present series is incomplete. In seeking an explanation of the deficiency we have divided the series according to place of birth (Table I). The observed incidence of mongolism is greater among infants born in hospitals than among domiciliary and nursing home births, although the domiciliary group, with a greater proportion of older mothers, would be expected to give a higher incidence than the hospital series.

TABLE I

INCIDENCE OF MONGOLISM AMONG BIRMINGHAM BIRTHS, 1942–52

Place of Birth	No. of Cases	Total Related Births (live and still)	Incidence per 1,000 Total Births
Hospital	120	99,228	1·21
Home and Nursing-Home	132	132,391	1·00
Total	252	231,619	1·09

Even among hospital-born children ascertainment appears to be incomplete. Incidences in the eight hospitals (Table II) show considerable variation (from 0·70 to 1·91 per 1,000 births).

Incomplete ascertainment would be less serious if cases could be regarded as being representative. Unfortunately the manner in which the series was assembled precludes any guarantee of randomness in so far as mortality is concerned. This is demonstrated in Table III, in which mortality rates of cases born in the three hospitals (A, E, and F) which recorded the highest incidence are compared with those of the remainder of the series. The comparison

TABLE II

INCIDENCE AMONG BIRMINGHAM HOSPITAL BIRTHS, 1942–52

Hospital	No. of Affected	Total Related Births (live and still)	Incidence per 1,000 Total Births
A	17	8,911	1·91
B	12	9,175	1·31
C	11	9,865	1·12
D	24	17,779	1·35
E	20	11,575	1·73
F	10	6,851	1·46
G	4	3,643	1·10
H	22	31,429	0·70
Total ..	120	99,228	1·21

is of course restricted to cases whose mothers were interviewed, since the fate of untraced cases was not known except for a few who had died; inclusion of these would have exaggerated the mortality rates. Individuals were assumed to have been at risk for half the age period in which they were at the time of interview. Their contribution to the "number at risk" was, therefore, only half that of an individual whose fate was known at the end of the period. Statistical treatment of the stillbirths required some consideration. It is, of course, unusual to extend a Life Table back to the period before birth, but there have been so few references to the possibility of mongols being born dead that it was considered desirable to focus attention on this point. We have therefore commenced the Life Table with the period "shortly before or during birth"; the precise extent of this period is immaterial.

Cases born in the three hospitals with the highest incidences (Group 1) show a considerable stillbirth rate, a very high neonatal death rate (especially in the first week), and thereafter a mortality rate very much greater than that for the general population of comparable age. The remainder of the series (Group 2) shows a much lower neonatal death rate than Group 1. The subsequent mortality up to age 5

TABLE III

MORTALITY RATES

Group	(1) Cases born in Hospitals A, E, and F					(2) Cases born Elsewhere					Mortality Rate of Whole Series (per cent.)
Age Period	No. Alive at Beginning of Period (*a*)	No. of Known Fate at End of Period (*b*)	Mean No. at Risk $\left(c=\frac{a+b}{2}\right)$	No. Dying during Period (*d*)	Mortality Rate $\left(\frac{d}{c}\times 100\right)$	No. Alive at Beginning of Period (*a*)	No. of Known Fate at End of Period (*b*)	Mean No. at Risk $\left(c=\frac{a+b}{2}\right)$	No. Dying during Period (*d*)	Mortality Rate $\left(\frac{d}{c}\times 100\right)$	
Shortly before or during Birth ..	35	35	35	3	**8·57**	182	182	182	1	0·55	1·84
—1 week	32	32	32	7	**21·87**	181	181	181	13	7·18	9·39
—1 month ..	25	25	25	3	**12·00**	168	168	168	11	6·55	7·25
—1 year	22	22	22	4	18·18	157	155	156	45	28·85	**27·53**
—2 years	18	14	16	2	12·50	110	105	107·5	4	3·72	**4·86**
—3 years	12	10	11	1	9·09	101	92	96·5	3	3·11	**3·72**
—4 years	9	6	7·5	0	—	89	85	87	1	1·15	**1·06**
—5 years	6	2	4	0	—	84	76	80	2	2·50	**2·38**

differs in detail from that of Group 1, but if survival for the whole period of 1 month to 5 years is calculated by the Life Table method, similar results are obtained for the two groups. The chance of an infant alive at 1 month surviving to 5 years is 0·651 for Group 1 and 0·635 for Group 2.

The incidence of mongols in the three hospitals comprising Group 1 (1·72 per 1,000 total births) is high enough to suggest that ascertainment is reasonably complete. We consider, therefore, that in spite of the small numbers of this group and the possibility that it may not be perfectly representative, it provides a more realiable estimate of neonatal mortality than the whole series, in which ascertainment of neonatal deaths is almost certainly deficient. The agreement between Groups 1 and 2 in survival rate after the first month suggests that they may be combined in assessing later mortality.

Survival rates based on the experience of Group 1 until the age of 1 month and thereafter on the whole series are given in Table IV. It is estimated that nearly two-fifths of mongols alive shortly before birth were dead by the end of the first month, less than half survived the first year, and only about two-fifths were still alive at 5 years. The survival rate at 1 year (45·6 per cent.) agrees well with an estimate made by Øster (1953) based on 72 hospital-born mongols, of whom 47 per cent. were alive at 1 year.

TABLE IV

ESTIMATED SURVIVAL RATES

(Based on figures in bold type in Table III)

Age	Number Alive
Shortly before Birth	1,000
Birth	914
1 week	714
1 month	629
1 year	456
2 years	433
3 years	417
4 years	413
5 years	403

There appears to be an interesting difference between males and females in respect of survival. The number of cases in Group 1 is too small to permit examination of mortality for each sex, and in what follows we have combined Groups 1 and 2. Mortality rates for males and females calculated by the method illustrated in Table III are given in Table V. These rates have been used to estimate the probable number of survivors at each age, and the percentage of males among the survivors has been calculated (Table VI). For most of the age periods studied, the mortality rates are higher for females than for males, and the sex-ratio (percentage of males) of survivors therefore shows a fairly steady rise with age.

TABLE V

MORTALITY RATES FOR MALES AND FEMALES

Age Period	Mortality Rate (per cent.)	
	Males	Females
Shortly before or during Birth	0·84	3·06
—1 week	5·93	13·68
—1 month	6·31	8·54
—1 year	26·92	28·00
—2 years	5·41	4·04
—3 years	1·54	7·06
—4 years	1·69	0·00
—5 years	0·00	6·35

TABLE VI

ESTIMATE OF SURVIVAL OF MALES AND FEMALES

Age	No. of Males Alive	No. of Females Alive	Sex-ratio of Living Mongols (per cent. male)
Shortly before birth	119·0	98·0	54·8
Birth	118·0	95·0	55·4
1 week	111·0	82·0	57·5
1 month	104·0	75·0	58·1
1 year	76·0	54·0	58·5
2 years	71·9	51·8	58·1
3 years	70·8	48·2	59·5
4 years	69·6	48·2	59·1
5 years	69·6	45·1	60·7

Before accepting this result we should inquire whether it may be explained by the method by which the series was assembled. For example, if parents were more agreeable to certification of the defective when the child was a boy, the sex-ratio of individuals alive from the age of 2 years (up to which time certification is rare) would obviously be greater than the sex-ratio at birth. But this explanation would not account for the steady rise in sex-ratio from "before birth" to the end of the first year. We conclude that among mongoloid defectives the mortality rate in infancy and early childhood is greater for females than for males. Penrose (1932) came to the same conclusion, but Hug (1951) rejected this view and demonstrated in his series of 130 mongols a higher mortality in males. Øster (1953) did not comment on this point, but his data on 460 mongols show that 59 per cent. of males and 67 per cent. of females had died at the time of follow-up.

In the whole series of 252 mongols, the number of known deaths was 116. In most cases the immediate cause of death was not certified. From the limited information available (Table VII, opposite), it would appear that death is most commonly ascribed to infections, especially of the respiratory tract, and to congenital malformations. The seasonal distribution of deaths (Table VIII, opposite) reflects the high incidence of respiratory infections.

TABLE VII
CERTIFIED CAUSE OF DEATH

Cause	Still Births	Neonatal Deaths	Later Infant Deaths	Deaths after First Year	Total
Infections of Respiratory Tract ..	—	2	16	5	23
Infections of Gastro-intestinal Tract	—	2	6	—	8
Congenital Malformations	—	10*	4†	1	15
Other	—	—	2‡	4§	6
Unknown	4	26	26	8	64
Total ..	4	40	54	18	116

* Congenital heart disease, 5; meningocoele, 1; duodenal stenosis, 1; sclerema neonatorum, 1; multiple malformations, 2.
† Congenital heart disease, 3; hydronephrosis, 1.
‡ Meningitis, 1; suffocation, 1.
§ Scarlet fever, 1; acute dilatation of the stomach, 1; sinus thrombosis, 1; suffocation, 1.

TABLE VIII
SEASONAL DISTRIBUTION* OF DEATHS

Month of Death	Still Births	Neonatal Deaths	Later Infant Deaths	Deaths after First Year	Total
January–March ..	—	11	23	5	39
April–June ..	1	11	9	3	24
July–September ..	1	9	11	4	25
October–December	2	9	11	4	26
Total ..	4	40	54	16	114

* Season unknown in two cases.

DISCUSSION

The results of this investigation indicate a considerable mortality among mongols in infancy. It follows that a series identified at an early age is likely to show a higher incidence than one in which diagnosis has been delayed. If, as our results suggest, female mongols experience a greater mortality rate than males, we should expect an inverse correlation between the recorded incidence of the condition in a series and the sex-ratio (expressed as the percentage of males) of its members.

Examination of our series according to place of birth supports this view, the sex-ratio being 48·9 per cent. for the three maternity units with a high incidence, 56·2 per cent. for the other hospitals, and 56·8 per cent. for domiciliary and nursing-home births (Table IX). Many of the cases in the last two groups were not, of course, diagnosed until a considerable time after birth, but even when a series is confined to individuals diagnosed in a maternity hospital the same inverse relationship between sex-ratio and incidence may be present. This may be demonstrated in a series published by Øster (1953); the numbers are small, but this disadvantage may be offset to some extent by the fact that the cases may be divided in two ways—according to place of birth and according to year of birth (Table X).

TABLE IX
INCIDENCE AND SEX-RATIO ACCORDING TO PLACE OF BIRTH
(Birmingham, 1942–52)

Place of Birth	Males	Females	Total	Related Births	Sex-ratio (per cent. male)	Incidence (per 1,000 births)
Hospitals A, E, and F ..	23	24	47	27,337	48·9	1·72
Other Hospitals ..	41	32	73	71,891	56·2	1·02
Home or Nursing-home ..	75	57	132	132,391	56·8	1·00
Total ..	139	113	252	231,619	55·2	1·09

TABLE X
INCIDENCE AND SEX-RATIO OF CASES BORN IN RIGSHOSPITALET, DENMARK
(Derived from data published by Øster, 1953)

Period	Department	Males	Females	Total	Related Births	Sex-ratio (per cent. male)	Incidence (per 1,000 Births)
1923–48	A	17	12	29	41,028	58·6	0·71
	B	22	20	42	43,044	52·4	0·98
1923–37	Both	12	7	19	44,284	63·2	0·43
1938–48		27	25	52	39,788	51·9	1·31

It follows from the foregoing that a series collected from mental deficiency institutions may be expected to show a high sex-ratio. Hug (1951) fully demonstrated this point (63·3 per cent. males in 982 institutional cases collected from the literature) and considered that it could not be explained by preferential selection of males for admission into institutions. Our evidence supports the view that the relatively low survival rate of females may account for this high sex-ratio, but Hug, having shown in his collection of 130 mongols a higher mortality rate in males, did not accept this explanation. He considered that the primary sex-ratio in mongolism is high and that the observed higher incidence in males cannot be explained by differences in mortality. In an attempt to support this view, he assembled data from ten publications which give maternal age and sex of mongols. He showed a falling sex-ratio with rising maternal age (63·5 per cent. male for mothers under 30, 61·1 per cent. for those aged 30–39, and 55·0 per cent. for those of 40 and over). From the analogy between these figures and those for all live births, he concluded that the pre-natal mortality rates of mongols increase with

maternal age and are higher for males than for females. But since few of the cases in this collection were ascertained at birth, the falling sex-ratio by maternal age does not necessarily reflect the influence of the intra-uterine environment. To test this point we have added our own cases from the three hospitals with high incidence to the two series from the literature in which it is reasonably certain that cases were diagnosed at or soon after birth and which gave sex and maternal age. The combined material (Table XI) fails to show the trend in sex-ratio by maternal age obtained by Hug.

TABLE XI

SEX RATIO ACCORDING TO MATERNAL AGE OF CASES DIAGNOSED AT BIRTH

Series	Maternal Age (yrs)					
	Under 30		30–39		40 and Over	
	M	F	M	F	M	F
Hug (1951)	16	10	42	19	27	16
Beidleman (1945)	4	10	7	9	4	8
Present series (Hospitals A, E, and F)	1	7	5	10	9	3
Total	21	27	54	38	40	27
Sex-ratio (per cent. males)	43·8		58·7		59·7	

Further suggestive evidence may be advanced against Hug's hypothesis. Table XII has been prepared from data published by Penrose (1934), the most extensive material on maternal age, birth rank, and sex of mongols available in the literature. Although a fairly coarse grouping has been used, numbers in some cells are inevitably small. Nevertheless there is a fairly regular rise in sex-ratio with birth rank and a fall with maternal age. The sex-ratio of all live births shows a very different pattern; it falls with birth rank if maternal age is fixed and shows no association with maternal age if birth rank is fixed (MacMahon and Pugh, 1953).

TABLE XII

SEX-RATIO* ACCORDING TO MATERNAL AGE AND BIRTH RANK

(From data recorded by Penrose, 1934)

Birth Rank	Maternal Age (yrs)		
	Under 30	30–39	40 and Over
1 and 2	54 (26)	60 (20)	43 (7)
3 and 4	100 (3)	64 (30)	50 (18)
5 and Over	— (1)	73 (41)	63 (78)

* Expressed as percentage of males.
Number of cases is given in brackets.

Hug's observation of a falling sex-ratio of mongols with advancing maternal age cannot, therefore, be explained by differential intra-uterine mortality. We consider that it is more likely to result from the influence of the post-natal environment. Support for this view is provided by a comparison of Penrose's material (Table XII) with infant mortality rates in Birmingham in 1947, calculated by Gibson and McKeown (1952), here repeated in abridged form (Table XIII). Groupings both of maternal age and of birth rank are not the same, but, whether the two Tables are compared vertically or horizontally, they show a close correspondence between the sex-ratio of mongols and the rate of infant mortality in the general population. Gibson and McKeown showed that deaths from infection accounted for nearly all the association between infant mortality and birth rank and maternal age. It is well recognized (and shown in our series—Table VII) that mongols are peculiarly susceptible to infection.

TABLE XIII

INFANT MORTALITY RATES* IN BIRMINGHAM, 1947, ACCORDING TO MATERNAL AGE AND BIRTH RANK

(Gibson and McKeown, 1952)

Birth Rank	Maternal Age (yrs)		
	Under 25	25–29	30 and Over
1	31·3	16·9	37·4
2	47·4	34·0	25·7
3	76·1	44·1	25·2
4 and Over	98·2	59·2	45·7

* Expressed as number of deaths per 1,000 live births.

Analysis of our data fails to show any consistent trend in sex-ratio either by maternal age or by birth rank. This is hardly surprising in view of the fact that our cases were, in general, diagnosed at a much earlier age than those in Penrose's series, and had, therefore been less influenced by the post-natal environment at the time of ascertainment.

We consider that these observations support the view that among mongols in an adverse environment females are more likely to die in early life than males, and that in order to assemble a representative series diagnosis early in the neonatal period is essential. Only some of our cases fulfil this condition, and it is probable that the whole series shows too low an incidence and too high a sex-ratio. Nevertheless it is possibly more representative than most other series which have been assembled, and we hope to publish a detailed examination of the material in a subsequent communication.

SUMMARY

(1) 252 mongols (1·09 per 1,000) were identified among 231,619 total births in Birmingham in the years 1942–52.

(2) It was estimated that nearly two-fifths of mongols alive shortly before birth were dead by the end of the first month, less than half survived the first year, and only about two-fifths were alive at 5 years.

(3) Females showed greater mortality rates in infancy and early childhood than males. It is suggested that this may account for the inverse relationship between sex-ratio and maternal age, and between sex-ratio and recorded incidence.

(4) Death was commonly ascribed to infections of the respiratory tract, and somewhat less frequently to congenital malformations and gastro-intestinal infections. More deaths occurred in the first quarter of the year than at other seasons.

For permission to examine records we are indebted to the staffs of Birmingham hospitals and to the Birmingham Maternity and Child Welfare and Mental Health Departments. Observations were recorded in the homes of cases by Miss Mary Gradwell and Miss Eileen Gibson.

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STUDY OF DOMICILIARY CONSULTATIONS

BY

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From the United Birmingham Hospitals

Recent trends in the administration of the Medical Services have tended to emphasize distinctions between medical practitioners of different vocations, and to draw attention to the need for re-synthesis of the profession as a whole. It is now well recognized that a close liaison between general practitioner and hospital is of great importance to the welfare of patients. The partnership of general practitioner and specialist in the field of domiciliary practice is equally important, and it was thought that a study of this relationship might be of value.

For this purpose the records of 1,014 domiciliary consultations have been examined. They were carried out by a general physician since the inception of the National Health Service, but not all of them under its auspices. The report includes the results of the consultations; the diagnosis, either provisional or final; and the immediate disposal of the patients. Unfortunately, some of the information was necessarily conjectural, and not all cases could be adequately followed up.

The age distribution of patients visited is shown in Table I; about half of them were over 60 years of age. The mean ages of males and females were 56·0 and 56·7 respectively, and for both sexes private patients were on the average several years older than patients seen through the National Health Service. In general practice it has been reported that female patients preponderate in both surgery and home consultations (Logan, 1953). In this series of domiciliary visits there was an excess of males (53·9 per cent. of the total).

Results of Consultations

In Table II the results of consultations are given in seven groups. Some consultations had more than one result, and the total number of results is therefore not the same as the number of consultations. The first group is one in which it was considered that the consultant had managed to make some material contribution, either to diagnosis or to treatment. This group accounted for approximately two-thirds of the practice. The method of classification, being based upon subjective assessment, is naturally liable to error, and it might be questioned whether a modification of the antibiotics used, a change in the dosage of digitalis, or the introduction

TABLE II

RESULTS OF CONSULTATIONS

Practitioner's diagnosis and/or treatment modified	702
Practitioner's diagnosis and/or treatment confirmed	205
Relatives re-assured	12
Hospital admission expedited	16
Hospital admission avoided	85
No apparent result	3
Revisits	111

TABLE I

AGE DISTRIBUTION OF NATIONAL HEALTH SERVICE AND PRIVATE PATIENTS

Sex	Type of Consultation	Age of Patients								Total		Mean Age (yrs)
		0–19		20–39		40–59		60 and over				
		No.	%	No.	%	No.	%	No.	%	No.	%	
Male	National Health Service	21	7·9	43	16·2	89	33·6	112	42·3	265	100	52·4
	Private	13	4·6	13	4·6	101	35·8	155	55·0	282	100	59·3
Female	National Health Service	13	4·9	44	16·7	77	29·3	129	49·0	263	100	55·4
	Private	6	2·9	24	11·8	60	29·4	114	55·9	204	100	59·6
Total		53	5·2	124	12·2	327	32·2	510	50·3	1,014	100	56·5

of some other drug, could be regarded as a material contribution to treatment.

In the second group the general practitioner had apparently requested the consultation to reassure himself that his diagnosis was correct, and no further steps in treatment were necessary. This accounted for approximately one-fifth of the domiciliary practice. In this group have been placed cases in which the doctor required the support of a consultant in discussing his proposed course of action with relatives.

The third group is a small one in which the main reason for consultation was apparently to reassure relatives who were dissatisfied with the conduct of the case; only three consultations fell into this category.

In the fourth group, consultation was required to obtain admission of the patient to hospital. The consultant is sometimes called out for this purpose; a recent example was a request to see a patient urgently in need of admission to a general hospital, for whom a bed would be found by the Bed Bureau provided a consultant confirmed the necessity for admission. Although one does not deprecate this method of dealing with awkward cases, they should not, and do not, form a major part of the consultant's work.

The fifth group, also a small one, consists of cases in which the consultation apparently made it possible to avoid admission to hospital. In addition, one or two cases were found each year in which it was strongly suspected that the services of a consultant were not really required. Finally, about one-tenth (111) of the consultations were concerned with assessing the progress of patients who had already been visited on a previous occasion.

Diagnosis

The classification in Table III is based upon the clinical diagnosis recorded at the time of consultation, and is not usually supported by further evidence, though confirmatory information from hospital investigations, follow-up observation, and other sources, have been used when available. The two commonest disease groups were cardiac failure (158 cases) and respiratory disorders (151 cases), which together accounted for nearly one-third of the total number of consultations. Other conditions, such as carcinoma, neurological disorders, coronary thrombosis, cerebral thrombosis, and alimentary disturbances, all occurred with reasonable frequency, each accounting for approximately 7 per cent. of the total.

Disposal

Of 1,014 cases shown in Table III, 321 (10·9 per cent.) required admission to hospital; 111 of these required admission urgently, and the remainder were put on the waiting list for admission for diagnosis or therapy. In addition, 93 patients, 9·2 per cent. of the total, required further investigation in hospital out-patient departments, or by private arrangements elsewhere.

TABLE III

DIAGNOSIS AND IMMEDIATE DISPOSAL OF PATIENTS VISITED

Diagnosis		Hospital Attention				Total	
		Advised			Not Advised		
		As In-Patient		As Out-Patient			
		Urgent	Not Urgent			No.	%
Circulatory System	Cardiac Failure	18	24	3	113	158	15·6
	Coronary Disease	16	5	7	60	88	8·7
	Other	8	5	5	25	43	4·2
Nervous System	Cerebral Thrombosis	3	6	1	52	62	6·1
	Psychiatric Disorder	—	8	5	39	52	5·1
	Other	14	19	7	39	79	7·8
Respiratory System	Acute Disease	9	13	10	52	84	8·3
	Subacute and Chronic Disease	6	12	18	31	67	6·6
Digestive System		9	21	6	24	60	5·9
Neoplasms	Bronchial Carcinoma	1	15	4	1	21	2·1
	Gastric Carcinoma	—	5	5	11	21	2·1
	Other	4	17	2	20	43	4·2
Acute Infections		9	7	4	39	59	5·8
"Rheumatic" Conditions		—	20	7	29	56	5·5
Miscellaneous		14	33	9	65	121	11·9
Total		111 (10·9%)	210 (20·7%)	93 (9·2%)	600 (59·2%)	1,014	100

The hospital admission rate varied with diagnosis. For example, three-quarters of the cases of carcinoma of the bronchus were admitted to hospital, sometimes because of the frequent masking of signs by superadded acute inflammatory changes, and sometimes because bronchoscopic confirmation was necessary. In carcinoma of the stomach, on the other hand, admission was much less frequent, chiefly because clinical evidence of metastatic spread so often rendered hospitalization fruitless.

It is concluded that one of the prime requirements of the general practitioner is the establishment of a clinical diagnosis upon which a working plan of management can be based. Such diagnosis is possible in a surprisingly high proportion of domiciliary consultations, higher than is usually achieved in out-patient departments or in consulting-room practice. The patient who is sufficiently ill to be confined to bed generally presents physical signs or symptoms of sufficient severity or significance to enable an adequate assessment to be made in one-third of cases. This group includes both incurable and benign conditions. For the former, the domiciliary consultation is valuable in determining the course of action best suited to the circumstances, so as to spare the patient the mental and physical disturbance of removal to hospital or clinic for observation and subsequent return home untreated. Of the benign or treatable cases, the reassurance of patients or relatives, and the mutual support of consultant and practitioner, is sufficient to fulfill the purpose of the consultation.

Summary

An analysis of 1,014 domiciliary consultations performed by a general physician at the request of general practitioners included an assessment of results of consultations; diagnosis; and immediate disposal of patients.

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SOCIAL MEDICINE STUDIES BASED ON CIVILIAN MEDICAL BOARD RECORDS

I. NATIONAL SERVICE REJECTS

BY

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By the regular publication of statistics based on Census data and death certificates the General Register Office has kept the United Kingdom so well informed that even the man in the street is aware when mortality changes of a disquieting or reassuring nature have occurred. But nowadays, when disease more often causes loss of working efficiency than premature death, a more sensitive instrument than mortality statistics is needed to measure the public health. Since there is no immediate possibility of supplementing the national register of deaths with one of disabilities, it is relevant to ask whether the optimum use is being made of the records of routine health examinations, in particular those of Civilian Medical Boards.

During the war over 7,000,000 men and 500,000 women from all walks of life registered under the National Service Acts and were screened by Civilian Medical Boards. According to the official report for the years 1939–45, one in seven of the men (17–45 yrs) and one in five of the women (18–35 yrs) were found to be either physically or mentally unfit to serve in the armed forces (Ministry of Labour and National Service, 1947). The rejection rate for the men increased four-fold between the youngest and oldest age groups (under 21 to over 36 years), and for women it increased from 7 to 17 per cent. (under 21 to over 31 years). To these meagre facts in the Ministry report can be added the work of some independent investigators. Men referred for a second opinion have provided clinical material for papers on glycosuria (Keeping and Lawrence, 1947) and cardiac abnormalities (Bourne, 1946; Parkinson and Hartley, 1946). The original records have also been used to study physique (Martin, 1949), stature and chest circumference (Clements and Pickett, 1952, 1954), general standards of fitness (Stewart and Hughes, 1949), and foot defects (Hewitt, Stewart, and Webb, 1953). There is, however, nothing to correspond to the detailed reports on the U.S.A. Selective Service Examinations (U.S. Government, 1948; Goldstein, 1951), and apart from the paper on foot defects no indication that the records of *clinical abnormalities* have ever been consulted except to settle individual pension claims.

Certain features of the records may explain this apparent lack of interest in the massed data. During 1939 and 1940 the findings of the Boards were entered in specially printed ledgers and a single line usually sufficed for each examination. In this form the entries under medical history and clinical findings were so cramped and illegible that Martin (1949) decided they were not worthy of analysis. In 1941 a new format was introduced and the Manual of Instructions to Examiners revised (Ministry of Labour and National Service, 1941). Henceforth each examination was accorded a page, foolscap size, with printed headings arranged under three sections. Each section was completed by a different examiner and the final grading was done in consultation with the Chairman, who was responsible for the general conduct of the examination and for referring men to consultants for specialist opinion.

In practice, under certain headings (*e.g.*, weight, height, chest, circumference, visual acuity, hearing standard, and medical grade) the entries were completed in nearly every case, while under others (*e.g.*, past illnesses, fits, heart, lungs, etc.) the spaces were frequently left blank or merely ticked. Though it is reasonable to suppose that in such cases the examiners thought that there was nothing of interest to record, there is no guarantee that they asked the same questions, kept exactly the same kind of record, or agreed about what constituted an abnormal finding. Therefore, in spite of the strict rules of procedure laid down in the Manual of Instructions, it is not safe to assume that the records of clinical abnormalities (as opposed to the records of weights and heights) are strictly comparable. Members of a single Board must have worked to a common convention, but it is unlikely that the same level of skill and accuracy was maintained in

* In receipt of a grant from the Medical Research Council.

all regions. On the contrary, it can be shown that when all the entries under medical history and clinical findings are included in the analysis there are significant differences between Boards which can only be accounted for by different standards of work (see Table I).

It is one thing to discover that some of the examinations were less fully recorded than others and another to say that the mass records are therefore valueless from the point of view of epidemiology. There is no reason to suppose, merely because a Board overlooked or failed to record minor deviations from normal, that it set different standards for, say, town-dwellers and villagers, clerical workers and labourers, tall men and short men, young men and old, to mention some of the environmental and constitutional factors which were recorded on the schedules and which it might be of interest to correlate with the prevalence of disease. Systematic bias of this kind is so improbable that, *provided the annual records of each Board are separately assessed*, there is no reason why the existence of "observer error" should prevent their use in establishing correlations between disease prevalence and other phenomena. From this point of view it is far more important that the men and women examined by Civilian Medical Boards should be typical of their regions, occupations, and age groups, than that the individual case records should be perfect. From another point of view it is of interest to know how the Service and Civilian reports on individuals compare: whether men who appeared before more than one Civilian Medical Board were similarly assessed,* and whether, at a level of disability sufficient to cause rejection, there was greater similarity between regions than at a level of minimal disability. It is only with this last point that the present paper is concerned, but further publications are contemplated in which the value of the records will be considered from other points of view.

* From January, 1943, it became the practice for Civilian Medical Boards to re-examine immediately before call-up men who (because they belonged to a reserved occupation) had not been medically examined in the last 6 months. There were also a number of men with temporary disabilities who were referred for second and third examinations.

Materials and Methods

The whole investigation is based on three sets of Civilian Medical Board records, each of which was compiled during the period 1941–44. Two of the examining panels worked in adjacent counties—Leicestershire and Northamptonshire—and the third served part of Essex. By the terms of the National Service Acts of 1939–44, men who were registered as having certain gross physical or mental defects† did not come before a Civilian Medical Board, but from 1943 onwards men in reserved occupations were examined, even though they were exempt from call-up. For a variety of reasons, no women, no men over 45, and no representatives of certain groups (*e.g.*, conscientious objectors, ministers of religion, and medical practitioners) are included in the investigation.

To facilitate manipulation of the records a code was devised which allowed everything recorded on the original schedules to be represented on two Powers Samas cards. This recording was based on the International Classification of Diseases and Injuries (World Health Organization, 1948) and the recent Census Classification of Occupations (General Register Office, 1951). The code included six age groups (17–19 yrs, and the four following 5-year groups), nine height groups (at intervals of 2 in.), ten weight groups (at intervals of 10 lb.), and four general fitness categories (Medical Grades I to IV).‡

† *E.g.*, inmates of lunatic asylums, persons with only one leg or permanently incapable of moving without assistance, and persons registered as totally blind or mentally defective.

‡ I—Fit for all forms of active service.
II—Fit for duties "not involving heavy strain".
III—Unfit for active service: possible reservist } National Service Rejects.
IV—Unfit for active service: in any circumstances } National Service Rejects.

TABLE I

PREVALENCE RATES IN THREE REGIONS, BY

Main Categories of Disease (International Classification)		I Infective	III Endocrine	V Personality	VI C.N.S. and Sense Organs	VII Circulatory	VIII Respiratory
All Entries	Essex	1·5	1·2	1·5	1·3	1·1	1·3
	Leicester	1·0	1·0	1·0	0·9	1·1	0·9
	Northampton	0·6	0·9	0·6	0·8	0·9	0·8
	Number of Cases	4,674	810	2,224	3,111	6,083	4,265
Principal Defects	Essex	1·1	*	1·3	1·1	0·8	0·8
	Leicester	1·0	*	0·9	1·1	1·0	1·3
	Northampton	0·9	*	0·8	0·8	1·2	0·9
	Number of Cases	751	174	751	1,349	1,165	370

* Included under Residue

After the first batch of records had been coded and returned to the archives it was discovered that, if a man in Medical Grade III or IV had had more than one illness, the one which had caused him to be rejected could not be identified. The code was immediately revised, but for this reason only 10,310 of the 23,201 records from Leicester are included in the studies of main reasons for rejection.

Principal Defects of National Service Rejects

There are several reasons why there may be a regional bias in the recording of diseases and injuries which have little or no bearing on a man's general standard of fitness for military service. Doctors tend to be more interested in some complaints than others, and to have greater skill in diagnosing diseases which have frequently come their way than diseases with which they are unfamiliar. Even strict rules of procedure and a sectional method of examination are not proof against such foibles, for it only requires the Chairmen of different Boards to set different standards of note-taking to introduce a regional bias into the records. On the other hand, diseases which caused rejection were less likely to have been omitted than those which had left little or nothing in the way of residual disability. Provided, therefore, the rejection standards were the same—and these were defined in detail in the Manual of Instructions—it might be possible to pool the records of the main reasons for rejection (here called *principal defects*) and estimate (for the ages and occupations represented) the prevalence, not of disease as a whole, but of cases in which a disease reached a conventional level of severity.

To discover how the records compared in these respects a comparison was made between morbidity rates based on:

(*i*) all entries under clinical findings and medical history,

(*ii*) *principal defects* of men in Medical Grades III and IV .

To construct Table I, diseases were grouped according to the seventeen main categories of disease in the International Classification (World Health Organization, 1948) and age-standardized rates were calculated for each panel and for all three regions combined. The rates for the combined regions were then scaled to unity and the corresponding rates for the three panels expressed as a ratio to the combined rates.

In the top half of Table I, where the ratios are based on "all entries", the figures for Northampton are invariably the lowest of the three, and with one exception those for Essex are the highest. In the total count the rates for Essex and Northampton lie 24 per cent. above and 24 per cent. below the rate for Leicester. The obvious inference is *not* that the Essex men were in all respects less healthy than the other men, but that the standard of recording was highest in Essex and lowest in Northampton.

In the lower half of Table I, where the ratios are based on the principal defects of men who had been rejected, the rank order of the three panels is no longer the same for every category of disease. Northampton still appears third in the final count, but the difference between Northampton and Essex is now only 4 per cent. Northampton only twice takes first place, which suggests that, even at the level of rejection, this panel had relatively lax standards. It also seems likely that the Leicester Board (which had the highest rejection rate) took a more serious view of respiratory and gastric disorder than either of the other panels, and that Essex was unusually strict in its assessment of personality disorders. On the other hand, allowance must be made for the fact that the three populations differed considerably in their occupational stratification (Table III), and it is clear that the regional differences are much reduced in the lower half of the

BY ENTRIES AND PRINCIPAL DEFECTS

IX Digestive	X Genito-urinary	XII Skin	XIII Bones and Organs of Movement	XVII Accidents	Residue	All Categories	No. of Men Examined
1·2	1·2	1·1	1·1	1·2	1·3	1·24	11,966
1·0	0·9	1·2	1·0	1·0	0·9	1·00	23,201
0·8	0·9	0·7	0·9	0·8	0·8	0·76	15,759
6,822	889	3,643	11,528	8,033	850	52,932	50,926
0·9	*	*	0·8	1·1	0·8	0·98	11,966
1·3	*	*	1·1	1·0	1·2	1·08	10,131
0·8	*	*	1·1	0·9	1·0	0·94	15,759
735	137	104	595	524	797†	7,031	37,856

† Including totals for III, X, and XII

Table. It would, therefore, seem justifiable to combine the three panels and obtain from the records of principal defects

(*i*) age-specific prevalence rates;
(*ii*) age-standardized prevalence rates for numerically important occupations.

DISTRIBUTION BY AGE OF PRINCIPAL DEFECTS.—Out of a total of 37,855 men examined by the three Boards, 7,031 (18·6 per cent.) were placed in Medical Grades III and IV. According to figures given in the Ministry of Labour report—which are based on *examinations*, not men—the rejection rate for the country as a whole was 16 per cent. The difference between the two rates is in line with the suggestion that the inclusion of re-examinations has led to an over-estimate of the numbers of fit men examined by Civilian Medical Boards (Ministry of Labour and National Service, 1947).

For men over 40 years of age the average rejection rate was over four times as high as for men under 20 years, but for individual causes of rejection there was great variation in the age gradient. In Table II the principal defects have been grouped into 25 categories. For five of these (sub-standard physique, sub-standard mentality, epilepsy, poliomyelitis, and valvular disease of the heart) there was virtually no increase with age, and for five others (varicosities, hypertension, hernia, peptic ulcer, and other digestive disorders) the rates for men in the oldest age group were anything from fifteen to over one hundred times as high as for the youngest men. Between these two extremes come such conditions as defective sight and hearing, non-pulmonary tuberculosis, and skin diseases (with a two- to three-fold increase over the age range), and mental instability, pulmonary tuberculosis, trauma, and lung diseases (with a four- to ten-fold increase).

Unlike other diseases with a pronounced age gradient, pulmonary tuberculosis and other respiratory diseases have a higher rate at ages 35–40 than at ages 40–44. Clinical work suggests that from the fifth decade of life onwards the number of deaths from pulmonary disease may exceed the number of *serious* new cases, thus reducing the prevalence rate among older men. A tailing-off in the oldest age group of the prevalence rate for peptic ulcer and the absence of any such decrease in the rate for hypertension may be explained in the same way. That is to say, at an age when death begins to take an appreciable toll of sufferers from peptic ulcer, hypertension is not yet a killing disease.

OCCUPATIONAL MORBIDITY RATES.—When the records for the three panels were combined, ten of the 28 Main Orders listed in the 1951 Census

TABLE II

PRINCIPAL DEFECTS OF NATIONAL SERVICE REJECTS

Age-specific rates per 1,000 men examined for 25 disease groups

Age Gradients	Age Groups	17–19	20–24	25–29	30–34	35–39	40–44	All Ages	Total Number of Cases
	Number Examined	11,177	5,227	3,276	7,073	7,864	3,238	37,855	
I. No Definite Trend	Poor Physique	4·3	3·6	3·4	4·4	8·9	4·9	5·2	195
	Illiteracy, etc.	9·0	8·4	6·1	7·1	12·5	16·4	9·7	366
	Epilepsy	3·1	2·9	4·0	4·0	5·3	4·6	3·9	148
	Poliomyelitis	3·0	5·9	4·0	5·8	5·7	4·3	4·7	177
	Valvular Disease of the Heart (congenital and rheumatic)	10·4	12·4	11·3	14·9	15·0	14·5	12·9	488
II. Two- to Three-fold Increase	Other C.N.S.	1·0	1·5	3·4	1·7	4·6	3·7	2·4	90
	Visual	7·2	12·2	11·6	12·4	20·4	19·8	13·1	494
	Auditory	8·6	9·8	14·4	20·1	25·2	25·6	16·3	618
	Endocrine	2·9	4·2	2·8	4·1	6·6	9·3	4·6	174
	Other Tuberculosis	2·4	2·9	5·5	5·6	5·2	5·3	4·1	156
	Genito-urinary	1·5	3·1	4·3	4·4	4·8	4·6	3·5	131
	Skin	1·3	1·2	3·1	3·7	4·6	3·7	2·8	104
III. Four- to Ten-fold Increase	Mental Instability	2·5	6·5	11·9	10·8	17·2	23·7	10·3	389
	Pulmonary Tuberculosis	4·2	7·3	9·2	15·4	17·0	16·1	10·8	410
	Other Respiratory	3·6	8·6	8·9	8·9	17·7	16·7	9·8	370
	Fractures, etc.	3·9	7·1	14·4	17·0	24·2	26·6	13·8	524
	Foot Defects	2·1	3·6	4·6	8·8	8·5	11·7	5·9	224
	Other Skeletal	3·2	7·5	7·3	11·6	16·4	18·8	9·8	371
	Other Cardiovascular	1·2	1·9	4·0	3·3	5·7	9·0	3·5	132
	Miscellaneous*	1·5	1·5	2·4	5·5	9·7	13·0	5·0	190
IV. More than Ten-fold Increase	Varicosities	0·2	1·3	11·9	12·9	16·7	26·9	9·4	357
	Hypertension	0·4	0·6	1·8	2·7	8·9	26·6	5·0	488
	Hernia	0·3	1·2	2·1	5·4	10·9	13·9	4·9	185
	Peptic Ulcer	0·9	2·3	7·6	16·3	24·7	27·5	11·8	445
	Other Intestinal	0·6	0·8	3·4	2·8	4·1	9·6	2·8	105
Total		79·3	118·3	163·4	209·6	300·5	356·8	186·0	7,031

* Comprising 7 with syphilis, 26 with anaemia, and 155 with multiple minor defects

Classification of Occupations (General Register Office, 1951) were found to be represented by more than a thousand men. By combining professional and administrative workers an eleventh group ("executives") of similar size was obtained. For each of these and for all occupations combined age-standardized rates for the 25 categories of principal defects were calculated (Table III). The all-causes prevalence rates ranged from 17 per cent. below to 32 per cent. above the standard rate. Five of the occupational groups had rates which were more than 10 per cent. below par, and three had rates which were more than 10 per cent. above.

Agricultural Workers.—The excess was due solely to the large number of illiterate and mentally defective men in the group. Mental instability, epilepsy and other diseases of the central nervous system were also unduly common; in spite of a high rate for hernias, this occupation had a rejection rate 8 per cent. below standard, for all other diseases combined. The mental characteristics of the group must be due to selective recruitment, but the existence of nine cases of hernia where only five were expected may be an indication of a genuine occupational risk.

Unskilled Workers.—This not only attracts men of low mental calibre, but, unlike farming, also provides a refuge for the physically handicapped. It was therefore expected that this group would have a high rejection rate both for trauma and for a wide range of diseases. What was not anticipated was that the rate for lung diseases other than tuberculosis would be one of the lowest in the series. According to mortality statistics (Registrar General, 1938 and 1954), pneumonia, bronchitis, and asthma are all, *as causes of death*, more common among unskilled labourers than in any other section of the community. But according to Hospital Morbidity Statistics (Mackay, 1951), asthma *as a cause of ill health* is a disease of affluence rather than of poverty. Since it was known that authentic cases of asthma were never placed higher than Medical Grade III (Ministry of Labour and National Service, 1941) a more detailed analysis of the

TABLE III

OCCUPATIONAL MORBIDITY RATES (PER 1,000 MEN EXAMINED), BY PREVALENCE OF PRINCIPAL DEFECTS

Occupational Groups (Registrar-General's Main Orders) ..	II Agriculture	VI Metal manufacture	VII Textile	VIII Leather	XIV Building	XVI, XIX Executive (Administrative and Professional)	XVII Transport	XVIII Commerce	XXIII Clerical	XXIV Warehouse	XXVI Unskilled	All Occupations
Poor physique ..	6	2	9	9	—	5	1	5	7	11	4	5·2
Illiteracy, etc. ..	33	1	8	10	14	1	8	7	3	8	24	9·7
Mental Instability ..	18	9	8	6	9	8	7	12	9	14	18	10·3
Epilepsy	6	2	3	4	4	2	4	4	2	2	8	3·9
Other C.N.S. ..	5	2	2	2	2	4	2	2	3	2	4	2·4
Vision	14	11	7	10	13	16	9	13	17	10	21	13·0
Auditory	17	15	17	18	19	9	13	19	8	19	29	16·3
Endocrine	4	4	7	4	3	6	4	6	2	4	4	4·6
Pulmonary Tuberculosis ..	9	7	13	11	6	8	9	13	11	12	13	10·8
Other Tuberculosis ..	2	4	4	5	3	3	3	5	3	7	5	4·1
Poliomyelitis ..	2	4	5	8	1	2	4	6	6	4	6	4·7
Fractures, etc. ..	14	20	12	13	13	9	14	14	8	18	20	13·8
Feet	6	5	4	11	6	4	7	6	5	1	6	5·4
Other Skeletal ..	6	10	13	10	8	6	7	13	6	8	13	9·8
Varicosities	5	4	11	16	6	4	8	10	7	9	9	9·4
Valvular Disease of the Heart	13	7	9	19	8	12	11	18	15	16	12	12·9
Hypertension ..	3	2	7	5	8	7	5	5	3	4	5	5·0
Other Cardiac ..	0	3	13	3	2	5	4	2	5	5	3	3·5
Respiratory	13	9	12	8	5	11	8	12	9	17	7	9·8
Hernia	9	5	4	6	5	5	4	5	2	4	6	4·9
Peptic Ulcer	7	16	16	7	9	15	11	13	10	16	14	11·8
Other Intestinal ..	3	2	5	4	1	7	4	2	5	1	3	2·8
Genito-urinary ..	3	5	11	3	3	5	2	5	4	1	3	3·5
Skin	5	3	5	2	5	2	2	4	1	3	5	2·8
Miscellaneous ..	5	4	10	4	4	7	5	6	4	4	6	5·0
Totals (as per cent. of Standard Rate) ..	112	85	116	108	83	87	84	103	83	107	132	100
Number of Men Examined:												
Essex	690	1,430	16	197	992	567	1,319	1,022	1,027	280	1,366	11,966
Leicester	192	1,008	1,520	1,320	295	544	583	1,013	717	459	652	10,130
Northampton ..	370	1,252	15	4,817	732	478	1,074	1,306	895	516	1,161	15,759

respiratory diseases group was made (Table IV). This showed that rejection was due to asthma in less than 20 per cent. of the cases of respiratory disease among the unskilled workers, compared with over 60 per cent. for executives and clerks.

TABLE IV
OCCUPATIONAL DISTRIBUTION OF AUTHENTIC CASES OF ASTHMA

Occupations	Rejections due to Respiratory Diseases*	Asthma as Percentage of Respiratory Cases
Agriculture	15	47·1
Metalwork	27	39·3
Textiles ..	23	40·9
Leather ..	54	40·8
Building ..	15	25·0
Executive ..	18	62·9
Transport ..	25	37·5
Commerce..	45	30·8
Clerical ..	19	64·7
Warehouse	23	25·0
Unskilled ..	24	17·4

* Excluding pulmonary tuberculosis.

Textile Workers.—This occupation had the second highest all-causes rejection rate, and was virtually confined to Leicestershire. Unlike the two preceding groups it had below-average rates for illiteracy and epilepsy, but for all other diseases combined it had an even higher rejection rate than that of unskilled work. Many men had sub-standard physique and multiple minor defects, and pulmonary tuberculosis was more common than in any other occupation. It was bracketed top with metal work for peptic ulcer, and for several of the more mixed disease categories (e.g. endocrine, other skeletal, other heart, other intestinal, genito-urinary, skin), it had the highest or second highest rates in the series. Since the occupation is far from homogeneous—including bleachers, dyers, weavers, and knitters—it is difficult to say whether the low standard of health should be ascribed to working conditions or to selective recruitment and bad living conditions. All that can be said for certain is that dermatitis is a known hazard of bleachers and dyers, that certain chemicals cause bladder irritation, and that an excessive amount of pulmonary tuberculosis has been found among women working in textile factories (Smith, 1947). There are also, in the 1931 Decennial Supplement for England and Wales, examples of high death rates for peptic ulcer among certain groups of textile workers (General Register Office, 1938). It is therefore possible that excessive exposure to dyes and bleaching agents may cause gastric and intestinal irritation.

Executive and Clerical Workers.—The two groups of office workers had several things in common besides a low all-causes rejection rate. They were above average in intelligence and mental stability, had exceptionally low rates for trauma, foot defects, and diseases of the ear (mainly suppurative otitis media), and rather high rates for eye diseases (mainly defective vision). In certain respects—notably hernia, skin diseases, and endocrine disturbances—the executives seemed to be worse off than the clerks, but in others—notably varicose veins, poliomyelitis, and other skeletal diseases—they appeared to advantage.

Manual Workers.—Three groups (metal, building, and transport) had low all-cause rejection rates, but apart from low rates for substandard physique, the occupations had little in common:

The *metal workers* owed their favourable position to low rates for illiteracy, epilepsy, and all forms of cardiovascular disease, but had high rates for peptic ulcer and trauma.

The *builders* had rather low rates for diseases of the alimentary tract, exceptionally low rates for all forms of lung disease, and more than twice the expected number of hypertensives.

The *transport workers* resembled the office workers in having "average" rates for a wide range of diseases, but they also had the lowest rates for eye diseases.

Leather Workers.—Most men in this occupation were boot and shoe factory operatives from Northampton and Leicester. The group had more than its fair share of men with substandard physique and tuberculosis, but was not the worst off in these respects. The men seemed, however, to be exceptionally prone to varicose veins, valvular disease of the heart, foot defects, and poliomyelitis. Two of these (varicose veins and foot defects) might well be due to prolonged standing in the same position, which is a feature of the shoemaking operations normally performed by men, but the other types of disease, which were also characteristic of *warehousemen*, are more likely to be due to selective recruitment. In common with other factory operatives not engaged in heavy work, the shoemakers, warehousemen, and textile workers were probably more exposed to tubercular infection than men engaged in outdoor occupations.

To sum up, even when individual causes of rejection are merged into 25 categories and only eleven (far from homogeneous) occupational groups are distinguished, it is still possible to demonstrate trade differences. It is not possible to say how truly representative the findings are, but most of the occupations for which statistics have been quoted are sufficiently well represented in other parts of the country for confirmatory evidence to be obtained.

By themselves the records cannot do more than suggest that certain disabilities are more likely to be due to working conditions than to selective recruitment, but if systematically explored along the lines suggested they might succeed in raising a number of useful questions and provoking new and profitable lines of inquiry.

SUMMARY

The scheme of pre-Service medical screening operated during and since the war has an important —but largely wasted—by-product in the millions of clinical records now held by the Ministry of Labour. It is proposed to illustrate the value of these records in a series of studies based on the examination of approximately 50,000 men. One of the chief problems in this work is the lack of any guarantee of uniformity in the standards of diagnosis and recording applied at different places and at different times. It is suggested that one way of overcoming this difficulty may be to restrict attention to cases of illness which reach a fairly well-defined level of severity: namely, that sufficient to justify rejection from military service. It is shown that certain causes of rejection, besides differing widely in age-distribution, also differ in the frequency with which they affect various occupational groups.

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SOCIAL MEDICINE STUDIES BASED ON CIVILIAN MEDICAL BOARD RECORDS

II. PHYSICAL AND OCCUPATIONAL CHARACTERISTICS OF MEN WITH VARICOSE CONDITIONS

BY

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There were several reasons why it seemed appropriate to include in a study of the wartime records of Civilian Medical Boards a detailed analysis of varicose veins, varicocoeles, and haemorrhoids. These three types of abnormally distended veins are known to be common, but exactly how common they are and who is most likely to be affected are questions which have never been satisfactorily answered. Mild cases need no treatment, severe cases are notoriously resistant to treatment, and the death rate is negligible. It is, therefore, hopeless to expect either hospital records or national statistics of mortality to yield accurate estimates of prevalence. Short of a planned survey, what is required is a medical census of the population with systematic recording of all clinical signs of venous incompetence. It is, therefore, particularly fortunate that, at a time when Civilian Medical Boards were examining a relatively broad cross-section of the community, the printed headings in the schedules included "Varicose Veins", "External Genitalia", and "Piles".

Material

These schedules and the method of coding the information they contained have already been described (Stewart, Webb, and Hewitt, 1955).

Briefly, they came from three regions (Essex, Leicestershire, and Northamptonshire) and represent men under 45 years of age who were called up for National Service during the period 1941–44. In the coded version of the records, which were transcribed on to Powers Samas punch cards, there were six age groups (17–19 years, and the four following 5-year groups), nine height groups (intervals of 2 in.), and ten weight groups (intervals of 10 lb.). All entries under medical history and clinical findings were given their International Code numbers (World Health Organization, 1948), and all occupations were identified in the 1951 Census (General Register Office, 1951) and given their appropriate Social Classes (I–V), Main Orders (I–XXVIII), and Sub-Orders (1–999). In approximately 6 per cent. of cases an occupation common to several trades (*e.g.*, cutters, fitters, finishers, inspectors, etc.) could not be exactly identified. In this and subsequent papers, these men will be found in one occupational group ("trade not identified"). The men who were weighed and measured were also placed in one of ninety body-build groups. These were not included in the original code, but it was assumed that all men at a given intersection of the nine height and ten weight categories were of similar build. For each of these ninety groups an average estimate of the index $Height \div \sqrt[3]{Weight}$ was obtained from the appropriate midpoints of the height and weight intervals. In the following account the ninety groups have been reduced to six by pooling.†

Aims and Methods

For reasons already discussed in the first paper of the present series (Stewart and others, 1955), Civilian Medical Board records do not provide a reliable basis for estimating total prevalence rates. It was decided, therefore, to limit the present investigation to a study of *relative rates* in groups defined by weight, height, body-build, occupation, and social class. With this end in view the following tabulations were prepared for all cards (48,908) and for cards with mention of varicose veins (3,582), varicocoele (1,773), and haemorrhoids (1,376):

(1) Joint frequency distribution by height and by weight,
(2) Distribution by main order occupations,
(3) Distribution by social class.

* In receipt of a grant from the Medical Research Council.

† The effect of this was to reduce the importance of errors caused by the original approximations.

By repeating each sorting eighteen times the three regions and the six age groups were distinguished in each set of tabulations.

The calculations based on these cross-correlations were designed to test five "null hypotheses": that all three varieties of venous incompetence occurred independently of the five characteristics named above (weight, height, body-build, occupation, and social class). The possibility that the number of times each condition was recorded might vary with age of the man examined and, to some extent, with the rigour of the examination, was allowed for by making separate calculations for each of the eighteen sub-groups.

The numbers of men "expected", on the basis of the null hypothesis, to fall into each intersection of height by weight, and into each of the main order occupations and social classes, were obtained by scaling each of the distributions down to the corresponding numbers of men with each type of abnormality. These "expected" numbers were then summed over the age groups for comparison with the actual numbers obtained. To test the null hypothesis concerning height, a further summation over weight was necessary; conversely, a summation over height was necessary to test the hypothesis concerning weight. Finally, when the results had been examined for each region separately, the three regions were aggregated to obtain a final comparison of actual with expected cases.

The findings were compared in two ways. First the technical significance of the departures from expectation were assessed by means of the χ^2 test. Secondly the magnitude and pattern of the departures from expectation were assessed by calculating a Standardized Prevalence Ratio:

$$(\text{S.P.R.} = \frac{\text{Actual Number}}{\text{Expected Number}} \times 100).$$

The ratios based on the final aggregations are shown for main order occupation and social class in Tables II and III, and for heights, weights, and body build in Figs 1 to 3. For the sake of uniformity in the figures, the three scales of measurement have been divided into the same number of sub-ranges.* The abscissae on the graphs represent either mid-points of a single coded group (heights and weights), or the weighted average of mid-points from a number of groups (body build), the weighting being determined by the "expected" number in each group.

Because of the varying numbers of cases on which they are based, the S.P.R.s are of unequal reliability. Following the practice of the Registrar-General, an arbitrary number of twenty cases was set as the limit below which no ratio would be calculated.

Though not essential to the main purposes of the present investigation, the regional prevalence rates for the three types of venous incompetence are shown in Table I. It will be seen that there was considerably less variation in the rates for varicose veins than in the rates for varicocoele and haemorrhoids, but this does not necessarily mean that varicose veins were more accurately recorded than the other conditions. Earlier tests have shown that the standard of recording was appreciably lower in Northamptonshire than in the other two regions.

TABLE I

RECORDED PREVALENCE OF VARICOSE CONDITIONS AMONG MEN EXAMINED AT THREE CIVILIAN MEDICAL BOARD CENTRES (1941–44)

Centre	Varicose Veins		Varicocoele		Haemorrhoids	
	Number	Per cent.	Number	Per cent.	Number	Per cent.
Essex	903	7·7	534	4·5	426	3·6
Leicester ..	1,636	7·2	840	3·7	632	2·8
Northampton	1,043	7·3	399	2·8	318	2·2
Total ..	3,582	7·3	1,773	3·6	1,376	2·8

There is also evidence, both in Table II of the previous paper and in Table II of this paper, that for men who work in boot and shoe factories, varicose veins are a genuine occupational risk. Since shoemaking is the staple trade of Northamptonshire (it accounted for 30 per cent. of the men examined in this region) it is reasonable to

TABLE II

COMPARATIVE PREVALENCE OF VARICOSE CONDITIONS IN TWELVE OCCUPATIONAL GROUPS

Significant departures from standard prevalence of 100 are indicated as follows:—* = $P<0·05$; ** = $P<0·01$; *** = $P<0·001$.

Occupational Groups	Registrar-General Main Orders	Standardized Prevalence Ratios† (S.P.R.s)		
		Varicose Veins	Varicocoele	Haemorrhoids
Professional and Administrative	XVI, XIX	81**	107	103
Commercial ..	XVIII	97	89	128***
Clerical	XXIII	69***	99	94
Boot and Shoe ..	VIII	116***	117**	96
Textile	VII	105	95	81*
Metal	VI	88	102	98
Trade not Defined‡	—	111	91	96
Warehouse ..	XXIV	103	110	108
Transport ..	XVII	95	92	99
Building, Agriculture	III, XIV	97	79**	96
Unskilled ..	XXVI	101	99	96
Other Occupations	Residue	101	109	105

* It was found that six was the largest number of divisions which always left a convenient number in the extreme groups.

† *i.e.*, standardized for age and region and expressed as a ratio of the standard rate of 100.

‡ See text.

expect an appreciable excess of varicose veins in the Northamptonshire sample. For similar reasons the relatively divergent rates for varicocoele and haemorrhoids should not be interpreted as geniune regional differences. Even if, as we suspect, slight cases in Northamptonshire were under-recorded, it will not have affected the S.P.R.s for these are based on *relative rates* within each region.

The age gradients of the three diseases provide a convenient illustration of the reliability of relative rates of morbidity for certain purposes. In all three regions these showed the same features. Thus the proportion of men with varicose veins and haemorrhoids steadily increased and eventually became over ten times greater after the age of 40 than before the age of 20. The prevalence of varicocoele, on the other hand, reached its maximum by 20 years and thereafter remained fairly level.

VARICOSITIES AND HEIGHT.—The first of the five null hypotheses—that varicose conditions occur independently of height—was decisively discredited by the statistical test both in the case of varicose veins and in the case of varicocoele. An increase of 10 in. in height (*i.e.*, from a point about two standard deviations below the mean to a point about two standard deviations above the mean) was accompanied by a three-fold increase in the prevalence of both conditions. This was true in each region taken separately (all six of the test results concerned gave value of $P < 0{\cdot}001$), and in every calculation the S.P.R.s increased with height in a more or less regular fashion.

Results from the aggregated material (Fig. 1) suggest that this dependence upon height may be adequately described by linear equations. By means of least squares it can be found that the linear equation of best fit to the ratios for varicose veins was:

$$R_{(vv)} = 9{\cdot}93\,H - 565{\cdot}9$$

in which $R_{(vv)}$ represents the risk of recording a case of varicose veins, expressed as a percentage of the risk for all examinees of a given age, and H represents the standing height in inches. This equation is not offered as a description of any natural law governing the prevalence of varicose veins. It is only meant to provide a basis for comparing the empirical relationship ascertained in this material with whatever may be found to apply elsewhere. The internal consistency of the present material does, however, imply that a similar equation might be derived for any large group of young men, as the coefficients of H in the corresponding equations for the three regions taken separately were:

Essex	+11·7	per cent. per inch.
Leicester ..	+ 9·4	
Northampton ..	+ 9·8	

Fig. 1 shows that the dependence of varicocoele upon height was similar to and (despite the smaller number of cases) more nearly linear than that of varicose veins.

The equation of best fit proved to be:

$$R_{(VAR)} = 9{\cdot}62\,H - 546{\cdot}9.$$

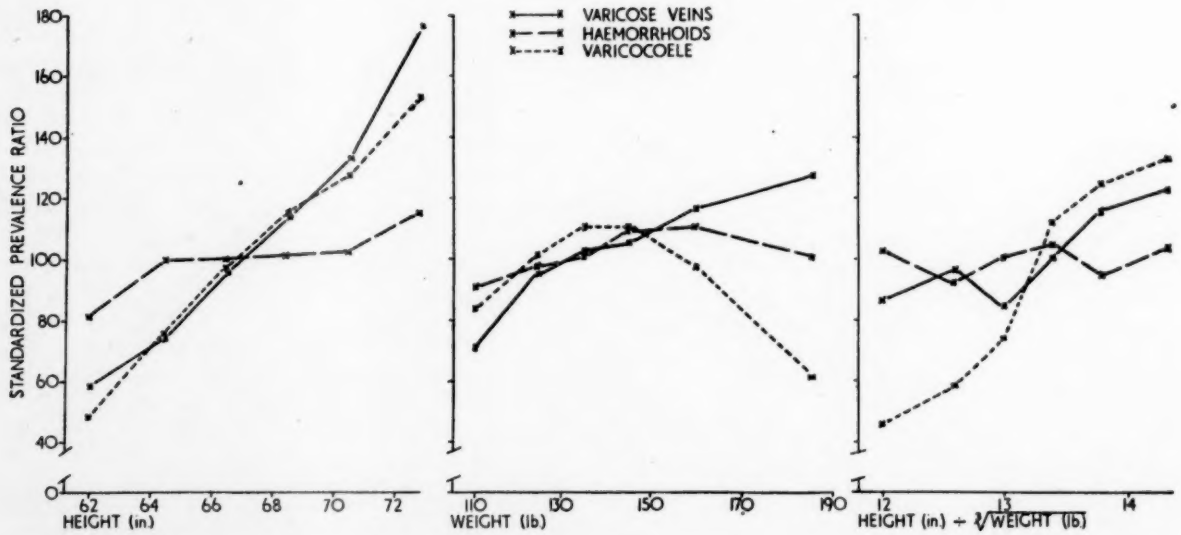

FIG. 1.—Standardized prevalence ratios related to height.

FIG. 2.—Standardized prevalence ratios related to weight.

FIG. 3.—Standardized prevalence ratios related to body-build.

The coefficients of H calculated from the separate regions were:

Essex	+ 8·5	per cent. per inch.
Leicester	+ 9·8	
Northampton	+10·5	

Although the tendency for the prevalence of varicocoele to increase with height applied with much the same force in all three regions, it did not apply equally to men of all ages. This was shown by calculating for each age group the prevalence among taller men (5ft. 6in. or more) and shorter men, and expressing the results as follows:

Age	*Ratio*
17–19	1·75
20–24	1·61
25–29	1·56
30–34	1·39
35–39	1·40
40–44	1·20

The apparent reduction with age in the slope of the line relating prevalence of varicocoele to height was confirmed in the results obtained independently from each region. Using the same ratio as above but compacting the age groups to maintain adequate numbers, the following result was obtained:

Age	*Essex*	*Leicester*	*Northampton*
17–29	1·60	1·67	1·79
30–44	1·23	1·43	1·44

Haemorrhoids did not show the same dependence on height, and although each point on the graph in Fig. 1 lies a little higher than the preceding point, by the χ^2 criterion, there is no significant departure from expectation.

VARICOSITIES AND WEIGHT.—Having found that varicose veins had such a well-defined relationship to height, we were virtually certain that some association with body weight would also be demonstrable (for the correlation coefficient between weight and height in the present sample was + 0·7). Fig. 2 shows that the prevalence of varicose veins was lowest among the men who weighed less than 120 lb., and increased continuously with increasing weight. However the gradient was not so steep as that of height, for although the extreme points on Fig. 2 are over five standard deviations apart, the increase in prevalence is less than two-fold (as against a three-fold increase with height over four standard deviations).

By contrast, the relationship between varicocoele and weight could not have been predicted from the earlier findings. Men with the lowest weights certainly had a statistically significant deficiency of cases, but the lowest prevalence was found among men who weighed over 180 lb. and a clear maximum occurred just above the average weight for all men examined. The location of this unexpected maximum showed some regional variation, but in all three samples the prevalence at both extremes of the weight scale was lower than at the centre.

The weight distributions of men with haemorrhoids did not differ significantly from the distributions of "expected" cases.

VARICOSITIES AND BODY-BUILD.—Fig. 3 shows how the prevalence of the three diseases varied along the body-build scale.

With varicose veins the highest prevalence was found in men who were exceptionally tall for their weight, the observed numbers differing from the expected number at the highest tabulated level of statistical significance. The average variation was, however, less extreme and less regular than it had been along either the height scale or the weight scale.

When the prevalence of varicocoele was plotted against the body-build index, the six points were found to lie on a fairly regular sigmoid curve, and the variation was almost as great as in the height graph. However, the lowest S.P.R. (46) in Fig. 3 corresponds to a more extreme body-build group than the lowest S.P.R. (48) in Fig. 1, for only the lowest 3 per cent. of the body-build distribution is covered, compared with 9 per cent. of the height distribution.

The departures from expectation in the case of haemorrhoids were irregular and, as before, too small to be regarded as significant.

VARICOSITIES AND OCCUPATION.—Each of the three diseases varied significantly with occupation, but not to the same degree. χ^2 tests with eleven degrees of freedom gave $P < 0{\cdot}001$ for varicose veins, $P < 0{\cdot}02$ for varicocoele, and $P < 0{\cdot}05$ for haemorrhoids.

The role of environment in the aetiology of varicose conditions is still uncertain but the general consensus of opinion is that the best preventives are regular exercise and no garters! Kramer (1948) has suggested that persons whose employment causes them to stand for long periods are especially liable to varicose veins, while Illingworth and Dick (1949) say that the condition is apt to occur in hyposthenic subjects of sedentary occupation. It is not clear whether by sedentary work these authors mean a "light job" or literally work done in the sitting position, but the one completely (and literally) sedentary group of workers in the present sample (clerks and typists) had, in all three regions, the *lowest* prevalence. The bulk of the professional

and administrative group were also office workers, and they too had low prevalence ratios. Boot and shoe factory operatives, on the other hand, who are compelled to stand in roughly the same position all day, and have little or no occasion to use their leg muscles,* had a significantly high ratio in both the regions where this occupation was represented (Leicester and Northampton). It must, however, be admitted that two occupations gave inconsistent results: unskilled labourers had S.P.R.s below 100 in Southend and Northampton but showed a 20 per cent. excess in Leicester. This may, of course, be due to regional differences in the jobs available to unskilled men. Transport workers also had a deficiency of cases in two regions and an excess in one, but the amount of sitting or standing to be done varies widely (a theme which has been developed by Morris and others (1953) in connection with another disease of the circulatory system).

One unexpected finding was that in each region the comparative freedom from varicose veins of the clerical workers appeared to diminish with age. For men under and over the age of 35 the S.P.R.s were as follows:

Clerical Workers	*Essex*	*Leicester*	*Northampton*
17–34 ..	37	61	35
35–44 ..	87	98	90

In the aggregated material the ratios were 33 for men under 25 years, 55 for men between 25 and 35 years, and 92 for men over 35. This raises the question whether it is only young persons, or persons who take active exercise in their spare time who benefit by a "sitting down" job.

The occupational distribution of varicocoele also revealed an exceptional risk for boot and shoe workers. The low prevalence of varicocoele in the group which included both builders and agricultural workers was found, on a more detailed analysis, to result from an exceptionally low prevalence among the agriculturalists. (This group was very small in the Leicester sample, but the S.P.R. was 54 for agricultural workers in Essex and Northampton. This result is probably related to the fact that active exercise prevents venous stasis).

A relation between occupation and haemorrhoids has often been suspected but never confirmed. According to Gabriel (1948) they are a special risk of porters, coal-heavers, and labourers because they strain themselves at work, of sedentary workers (because they strain themselves on holiday), of drivers of trams and shop-walkers (because they stand for long periods at work), and of those who do much riding on horseback or sit cross-legged at work! However this may be, there were only two occupational groups in the present series with S.P.R.s which lay outside the narrow range of 94 and 108; the only outstanding finding was a ratio of 128 for men employed in commerce (mainly shop assistants). According to the χ^2 test this one group (which had exceptionally high rates in all three regions) contributed no less than 11·94 to the total of 19·38 for eleven degrees of freedom. Since this result can hardly be attributed to chance it certainly warrants more detailed investigation.

VARICOSITIES AND SOCIAL CLASS.—Table III shows S.P.R.s for the three conditions by social classes.

TABLE III

COMPARATIVE PREVALENCE OF VARICOSE CONDITIONS IN THE REGISTRAR-GENERAL'S SOCIAL CLASSES

Social Class	Varicose Veins	Varicocoele	Haemorrhoids
I and II	84	96	112
III	101	104	100
IV	108	94	97
V	102	88	90

Only varicose veins showed a distribution of cases which has to be regarded as significantly different from expectation. This is evidently due to the low ratio (84) for Social Classes I and II combined. Since this figure is identical with the S.P.R. for professional and administrative workers, and since these men constitute the bulk of Social Class I and II, it is clear that the classification by social class has added nothing to the classification by main order occupations.

Although the Social Class S.P.R.s for haemorrhoids do not differ significantly from 100 it will be noted that there is a steady trend from the wealthiest to the poorest group. Alone of the three varicose conditions, haemorrhoids produced more than twenty cases in Social Class I, and the combined group in Table III may be divided as follows: Social Class I, 138; Social Class II, 109. The consistent ranking is therefore maintained through the full range of social classes.

DISCUSSION

Varicose veins and varicocoele have both shown such strong and regular associations with height that it is hard to resist the idea of a causal relationship. In both cases, but more particularly for varicocoele, there was some suggestion of weight and body-build influences which slightly complicated

* There are sitting jobs in shoe factories but these tend to be monopolized by the women.

the issue. It was, however, height which yielded the greatest departure from the "expected" distribution, and it was height which showed the simplest graphical relations. There is, therefore, good reason to suppose that this factor (which certainly influences venous pressure) is the most important correlate of the three. If so, the associations with weight and body-build would be regarded merely as corollaries of the following proposition: that in young men the risk of contracting either varicose veins or varicocoele is directly proportional to the length of the veins in the lower half of the body.

Haemorrhoids did not show such close dependence on any of the three dimensional variables. Nevertheless the result which most nearly approached statistical significance was that for height, and once again the tallest men showed the greatest prevalence. The results for haemorrhoids should, however, be read with special caution, for unlike varicose veins and varicocoele it was recorded more frequently at the upper than at the lower end of the social scale (*i.e.*, in the section of the community which is by and large the tallest and the heaviest).

Studies in constitutional medicine usually take as their starting point certain pre-conceived "body types"* (Sheldon and others, 1940; Kretschmer, 1944). It is, however, possible that for estimating certain disease risks *absolute* dimensions are more important than relative dimensions. Certainly, the stock index of body-build ($H \div \sqrt[3]{W}$) is a very crude measure of physique. This fact, together with the imperfect way in which the index had to be applied, may have led to our underestimating the importance of body-build in relation to varicosities. On the other hand, this same index, used in precisely the same way, has for certain risks (*e.g.*, foot defects, hernia, and spinal curvature) given better discriminations than height or weight taken alone (Hewitt and others, 1953; Webb and others, 1955).

By comparison with the earlier findings the effects of occupation and social class appear slight. There are, however, several points of interest. The absence of any excess of varicose veins and varicocoele in the upper (taller) social classes means that there has, for once, been no confusion between constitutional and environmental effects. *Per contra*, what appears to be a slight "haemorrhoidal diathesis" may be nothing more than a coincidence between habits of behaviour and physical type.

* It is not difficult to infer how the present findings would have appeared if the investigation had been based on somatotypes. In view of the known relations between the recognized somatotype groups and the body-build index we have used, it is certain that a significant excess of both varicose veins and varicocoele would have been found among ectomorphs and corresponding deficiency among endomorphs.

The valves in the femoral vein are relatively ineffectual structures and the regular contraction and relaxation of the deep leg muscles is largely responsible for the upward blood flow. Even at rest these rhythmic movements persist and provided one is sitting or lying the veins work perfectly well. Prolonged standing, on the other hand, is not a natural habit in man, and it certainly hampers the blood flow in the lower half of the body. It is not surprising therefore that varicose veins and varicosities should be common in members of an occupational group who for all intents and purposes neither sit down nor walk about. There must, of course, be small sub-groups of such men in other industries, but in a broad classification of occupations they are likely to be outnumbered by those whose work involves a wider range of movement.

The difference between the younger and older clerks raises the question whether the effects of occupation on health are necessarily most clearly seen in workers who have been exposed to the relevant conditions for a long time. In the case of a slow cumulative poison such as quartz dust, this must be so, but where the effects depend on the absence of some factor which is common to the population at large it need not be so. In the present instance it is possible that a particularly favourable blend of rest at work and exercise during spare time is characteristic of young male clerks but not of their older colleagues.

Summary

Several thousand cases of varicose veins, varicocoele, and haemorrhoids reported by Civilian Medical Boards were studied in relation to the height, weight, body-build, occupation, and social class of the men examined.

It was found that the tendency to varicose veins increased steadily with increasing height but showed little association with weight or body-build. Varicocoele and height were also associated, but tall men became less liable to variocoele with advancing age, and men who, though not exceptionally tall, were tall for their weight were more liable.

Boot and shoe factory operatives were found to have more than their fair share of varicose veins and varicocoele, and both these conditions were comparatively infrequent among young clerical workers. For these two diseases there was no regular social gradient. Haemorrhoids seemed to be more common among Social Classes I and II, but the only statistically significant finding for this disease was an exceptionally large number of cases among shop assistants and other men in commercial occupations.

We should like to record our thanks to the Nuffield Provincial Hospitals Trust and the Medical Research Council who contributed generously towards the expenses of the investigation.

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IMPREGNATION OF HANDKERCHIEFS, ULTRA-VIOLET LIGHTING, AND OTHER CONTROL METHODS IN PREVENTION OF UPPER RESPIRATORY DISEASE

BY

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From the Directorate of Hygiene and Research, Air Ministry

A large training station of the Royal Air Force, situated in Southern England, offered unusually good facilities for controlled trials of possible methods of reducing the spread and incidence of upper respiratory infections.

MATERIAL

The total population of some 4,000 persons included at the relevant times between 1,200 and 1,800 young apprentices organized in three "Wings". Each of these wings had its own similar barrack and dining rooms (in permanent brick buildings), its own Service Institutes for use in leisure hours, and its own specially allotted sections of the large and airy workshops. Intermingling of the wings was, therefore, largely limited to open-air activities, with, to a smaller extent, some mixing off-duty and in a communal station cinema. The wings were themselves sub-divided into three "Squadrons", and these too, were fairly self-contained and separate units, though not so decisively separated as the wings. In general, this structure, coupled with a highly organized medical service and method of sickness recording, made it administratively possible, and indeed simple, to set up "experimental" groups to be compared with "control" groups, both groups being very similar in their characteristics and conditions of life, but living and working largely apart.

The apprentices enter the service, usually direct from school, between the ages of 15½ and 17 in thrice-yearly entries; and they remain on the station for 3 years. Their health is good and their height and weight gains during the 3 years equal to, or better than, the average of youths in other occupations (Morant, 1949). The station was organized as a school with three terms per year, each with a short mid-term break, and holidays at the usual times but rather shorter than normal.

PROCEDURE

In this setting it was decided to make a trial of impregnated handkerchiefs as a possible means of reducing the spread of upper respiratory infections.

METHODS OF IMPREGNATION.—Dumbell, Lovelock, and Lowbury (1948) drew attention to the large number of airborne bacteria-carrying particles which were liberated by a handkerchief as normally used, and in a subsequent paper, Dumbell and Lovelock (1949) reported that handkerchiefs could be impregnated with various substances which would sterilize the nasal secretion deposited therein. The problem in the present trial was to find a practical method of impregnating handkerchiefs on a relatively large scale.

Solutions of hexyl resorcinol and of octyl cresol, emulsions of these substances, and direct application by a roller machine (not unlike a domestic mangle) were all tried and discarded: a reasonable consistency of impregnation allied to ease of application was eventually achieved by immersing handkerchiefs in a solution of octyl cresol in 60 per cent. alcohol. The handkerchiefs were then transferred to a very large bath of water, when most of the octyl cresol was retained in the cotton and only one-quarter to one-third was washed away with the alcohol. Impregnated in this way, handkerchiefs were found to reduce the numbers of particles carrying viable bacteria to an extent comparable with the handkerchiefs which Dumbell and Lovelock impregnated direct from alcoholic solution in their small-scale experiments. This method of impregnation was therefore adopted, although the calendering raised an unexpected difficulty in that the heated rollers caused the emission of an irritating vapour, the equivalent of a fairly effective tear gas, which almost incapacitated the operators. It was found essential for the operators to wear service anti-gas respirators—a tiresome procedure which clearly debars the use of octyl cresol on any large scale. In the present research it was in fact used in Trials I to IV.

At a later stage attention was turned to the use of glycollic acid when various new difficulties had to

be overcome. The technique employed with octyl cresol and described above was unsatisfactory owing to precipitations of calcium salts from previous laundering; but a small roller machine which had been tried before was used with some success. In this machine, rollers dipping in a trough of glycollic acid transferred the latter with reasonable consistency to the handkerchiefs. On the other hand calendering was even more difficult, for when impregnated with glycollic acid the handkerchiefs stuck to the cloths of the calender, were awkward to remove from its rollers, and frequently tore its cloths. Glycollic acid was also found to cause rapid deterioration of the material of the handkerchiefs, and this ultimately brought the trial to an end (Trial V). Throughout the trials a sample of handkerchiefs was taken from each batch after calendering for a test of the impregnation—to ensure that consistent amounts were being applied and that no undue build-up of the chemical was occurring. In addition a bacteriological check was made at intervals. It was found that neither of the chemicals was as bactericidal when used on a large scale in the ways described above as in the laboratory trials with a small number of handkerchiefs. Octyl cresol was particularly disappointing.

Distinctive handkerchiefs with brightly coloured borders were obtained especially for the trials. The leading apprentice in charge of each barrack room (with a maximum of twenty occupants) was made responsible for their collection and issue; but individuals could make personal exchanges at any time in cases of necessity.

RECORDS OF ILLNESS.—Records of attacks of upper respiratory disease came from two sources:—

(*a*) Attendances at the regular morning sick parade.

(*b*) Reports of attacks of the common cold which did not bring an apprentice to the sick parade but which he was specially instructed to report to the leading apprentice in charge of his barrack room.

Checks on these latter records were made throughout the trials by drawing at random a one per cent. sample of the population for interview. At these interviews the frequency of colds which had not been reported could be assessed. A 10 per cent. random sample of those reporting a cold was also drawn regularly to determine what was comprised by these self-diagnosed "colds".

The clinical diagnoses of upper respiratory complaints seen at the daily sick parade were divided into three groups:

(*i*) *Cold.*—The condition normally so called, characterized by sneezing, rhinorrhea and/or catarrh, lacrimation, etc., with or without pyrexia.

(*ii*) *Sore Throat.*—A symptomatic diagnosis embracing tonsillitis and pharyngitis.

(*iii*) *Influenza.*—A febrile condition without localizing signs but with general symptoms such as limb pains and weakness.

(*iv*) *Self-Diagnosed "Colds".*—These were separately tabulated.

RESULTS

TRIAL I (*March 6 to May 20, 1950*).—In the first trial handkerchiefs were issued to all 1,500 apprentices in the three wings. Those issued to one particular wing were impregnated with octyl cresol; the remainder were untreated. After 4–5 weeks on this basis and following the mid-term break, all handkerchiefs were collected. On re-issue a different wing received the impregnated handkerchiefs. Such changes were, of course, unknown to the apprentices.

While there was no evidence that the impregnation was having any appreciable effect upon the occurrence of upper respiratory disease, it was found that the scale of the trial was too large for close and adequate supervision, and this trial was, therefore, abandoned.

TRIAL II (*August 28, 1950, to April 14, 1951*).—Arising out of the experience of the first trial it was decided to issue handkerchiefs to one wing only. The three squadrons of this wing would form "experimental" and "control" units for comparison one with another and also to some extent, with the other wings to which no handkerchiefs had been issued. The squadrons of No. 3 wing were selected since they had between them a trade division which ensured a greater separation at work than was the case with the squadrons of the other wings.

Handkerchiefs issued to two squadrons were impregnated with octyl cresol, those to the other squadron were untreated. Four handkerchiefs were issued weekly to each apprentice, but any apprentice using up his allocation before the end of the week could obtain a fresh supply on a one-for-one basis by a personal visit to sick quarters. Frequent checks were made by irregular inspections to ensure that the issued handkerchiefs, and not others, were being used, and several talks on the value and importance of the trials were given to the whole wing.

The results of Trial II are given in Table I. They show no differences between the group incidence of the various respiratory infections. The two squadrons given handkerchiefs impregnated with

TABLE I

HANDKERCHIEF TRIAL II

AVERAGE WEEKLY INCIDENCE OF UPPER RESPIRATORY DISEASES FROM AUGUST 28, 1950, TO APRIL 14, 1951*

Unit	Average Population	Colds		Influenza		Sore Throats		Self-Reported Colds		Total Colds (Per cent.)	Special Handkerchiefs Issued
		%	No.	%	No.	%	No.	%	No.		
1 Wing (Control)	456	2·2	270	0·7	83	0·8	98	4·7	582	6·9	None
2 Wing (Control)	309	2·6	214	0·6	51	1·0	88	4·1	338	6·7	None
3 Wing											
"A" Sqdn (Control)	196	2·2	118	0·5	24	0·7	36	5·2	274	7·4	Not impregnated
"B" Sqdn (Trial)	185	2·0	101	0·6	31	0·7	33	3·3	165	5·3	Impregnated, Octyl cresol
"C" Sqdn (Trial)	210	2·7	154	1·2	64	0·8	45	7·1	402	9·8	Impregnated, Octyl cresol

* Excluding the Christmas holiday

octyl cresol had, taken together, an incidence rate of 2·4 per cent. for colds diagnosed at sick parade and 5·3 per cent. for self-reported colds. The corresponding rates for the "control" squadron were 2·2 per cent. and 5·2 per cent.

TRIAL III (*September 1, 1951, to April 5, 1952*).—Despite this negative result, and pending the development of other possible methods of control, a further trial of handkerchiefs impregnated with octyl cresol was set in train. In the autumn and winter 1951–52 they were issued to one squadron while a second squadron received untreated handkerchiefs. The comparison of their experiences, and those of Wing No. 2, is given in Table II. Once again no significant distinction between the trial and control groups was found.

TRIAL IV (*October 20, 1951, to April 5, 1952*).—Shortly after the start of Trial III a more comprehensive attempt was made to reduce the spread of upper respiratory infection. The aim was to close at the same time as many potential routes of spread as possible. If this "combined operation" should fail, then it would seem that further action towards the control of respiratory infections must await new knowledge of modes of spread and prevention. The potential routes taken into account and the means used to close them were as follows:

(*a*) Airborne infection in barrack rooms/Ultra violet irradiation of the air.

(*b*) Dustborne infection in barrack rooms/Oiling of floors and oil impregnation of bed-clothes and pyjamas.

(*c*) Direct droplet spread in barrack rooms/Screens between the beds.

(*d*) Infection from handkerchiefs/Impregnated handkerchiefs.

These measures were directed, it will be seen, mainly to the living accommodation. The workshops were too large and dispersed for any attempt at aerial control.

(*a*) *Ultra-Violet Lighting*.—Owing to the relatively low ceiling height specially modified lamps* were installed. The efficiency of the irradiation could not be tested by routine air sampling since the oiling of the floor and textiles might also be playing a part. A deliberate contamination of the air was therefore required. Experience indicated that a natural and reproducible contamination could be produced by a "spraying spit"—which phrase implies the assembling of a quantity of saliva in the mouth, and its dispersal by violent blowing out through partially closed lips

* Loaned by British Thomson-Houston Ltd.

TABLE II

HANDKERCHIEF TRIAL III

AVERAGE WEEKLY INCIDENCE OF UPPER RESPIRATORY DISEASES FROM AUGUST 27, 1951, TO APRIL 5, 1952*

Unit	Average Population	Colds		Influenza		Sore Throats		Self-Reported Colds		Total Colds (Per cent.)	Special Handkerchiefs Issued
		%	No.	%	No.	%	No.	%	No.		
2 Wing (Control)	560	2·3	386	0·12	20	0·6	108	4·2	701	6·5	None
3 Wing											
"A" Sqdn (Control)	184	1·4	78	0·04	2*	0·8	44	5·4	296	6·8	Not impregnated
"B" Sqdn (Trial)	142	1·6	70	0·09	4	0·6	27	7·3	310	8·9	Impregnated, Octyl cresol

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V	102	88	90

Only varicose veins showed a distribution of cases which has to be regarded as significantly different from expectation. This is evidently due to the low ratio (84) for Social Classes I and II combined. Since this figure is identical with the S.P.R. for professional and administrative workers, and since these men constitute the bulk of Social Class I and II, it is clear that the classification by social class has added nothing to the classification by main order occupations.

Although the Social Class S.P.R.s for haemorrhoids do not differ significantly from 100 it will be noted that there is a steady trend from the wealthiest to the poorest group. Alone of the three varicose conditions, haemorrhoids produced more than twenty cases in Social Class I, and the combined group in Table III may be divided as follows: Social Class I, 138; Social Class II, 109. The consistent ranking is therefore maintained through the full range of social classes.

DISCUSSION

Varicose veins and varicocoele have both shown such strong and regular associations with height that it is hard to resist the idea of a causal relationship. In both cases, but more particularly for varicocoele, there was some suggestion of weight and body-build influences which slightly complicated

* There are sitting jobs in shoe factories but these tend to be monopolized by the women.

the issue. It was, however, height which yielded the greatest departure from the "expected" distribution, and it was height which showed the simplest graphical relations. There is, therefore, good reason to suppose that this factor (which certainly influences venous pressure) is the most important correlate of the three. If so, the associations with weight and body-build would be regarded merely as corollaries of the following proposition: that in young men the risk of contracting either varicose veins or varicocoele is directly proportional to the length of the veins in the lower half of the body.

Haemorrhoids did not show such close dependence on any of the three dimensional variables. Nevertheless the result which most nearly approached statistical significance was that for height, and once again the tallest men showed the greatest prevalence. The results for haemorrhoids should, however, be read with special caution, for unlike varicose veins and varicocoele it was recorded more frequently at the upper than at the lower end of the social scale (*i.e.*, in the section of the community which is by and large the tallest and the heaviest).

Studies in constitutional medicine usually take as their starting point certain pre-conceived "body types"* (Sheldon and others, 1940; Kretschmer, 1944). It is, however, possible that for estimating certain disease risks *absolute* dimensions are more important than relative dimensions. Certainly, the stock index of body-build ($H \div \sqrt[3]{W}$) is a very crude measure of physique. This fact, together with the imperfect way in which the index had to be applied, may have led to our underestimating the importance of body-build in relation to varicosities. On the other hand, this same index, used in precisely the same way, has for certain risks (*e.g.*, foot defects, hernia, and spinal curvature) given better discriminations than height or weight taken alone (Hewitt and others, 1953; Webb and others, 1955).

By comparison with the earlier findings the effects of occupation and social class appear slight. There are, however, several points of interest. The absence of any excess of varicose veins and varicocoele in the upper (taller) social classes means that there has, for once, been no confusion between constitutional and environmental effects. *Per contra*, what appears to be a slight "haemorrhoidal diathesis" may be nothing more than a coincidence between habits of behaviour and physical type.

* It is not difficult to infer how the present findings would have appeared if the investigation had been based on somatotypes. In view of the known relations between the recognized somatotype groups and the body-build index we have used, it is certain that a significant excess of both varicose veins and varicocoele would have been found among ectomorphs and corresponding deficiency among endomorphs.

The valves in the femoral vein are relatively ineffectual structures and the regular contraction and relaxation of the deep leg muscles is largely responsible for the upward blood flow. Even at rest these rhythmic movements persist and provided one is sitting or lying the veins work perfectly well. Prolonged standing, on the other hand, is not a natural habit in man, and it certainly hampers the blood flow in the lower half of the body. It is not surprising therefore that varicose veins and varicosities should be common in members of an occupational group who for all intents and purposes neither sit down nor walk about. There must, of course, be small sub-groups of such men in other industries, but in a broad classification of occupations they are likely to be outnumbered by those whose work involves a wider range of movement.

The difference between the younger and older clerks raises the question whether the effects of occupation on health are necessarily most clearly seen in workers who have been exposed to the relevant conditions for a long time. In the case of a slow cumulative poison such as quartz dust, this must be so, but where the effects depend on the absence of some factor which is common to the population at large it need not be so. In the present instance it is possible that a particularly favourable blend of rest at work and exercise during spare time is characteristic of young male clerks but not of their older colleagues.

Summary

Several thousand cases of varicose veins, varicocoele, and haemorrhoids reported by Civilian Medical Boards were studied in relation to the height, weight, body-build, occupation, and social class of the men examined.

It was found that the tendency to varicose veins increased steadily with increasing height but showed little association with weight or body-build. Varicocoele and height were also associated, but tall men became less liable to variocoele with advancing age, and men who, though not exceptionally tall, were tall for their weight were more liable.

Boot and shoe factory operatives were found to have more than their fair share of varicose veins and varicocoele, and both these conditions were comparatively infrequent among young clerical workers. For these two diseases there was no regular social gradient. Haemorrhoids seemed to be more common among Social Classes I and II, but the only statistically significant finding for this disease was an exceptionally large number of cases among shop assistants and other men in commercial occupations.

We should like to record our thanks to the Nuffield Provincial Hospitals Trust and the Medical Research Council who contributed generously towards the expenses of the investigation.

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IMPREGNATION OF HANDKERCHIEFS, ULTRA-VIOLET LIGHTING, AND OTHER CONTROL METHODS IN PREVENTION OF UPPER RESPIRATORY DISEASE

BY

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A large training station of the Royal Air Force, situated in Southern England, offered unusually good facilities for controlled trials of possible methods of reducing the spread and incidence of upper respiratory infections.

Material

The total population of some 4,000 persons included at the relevant times between 1,200 and 1,800 young apprentices organized in three "Wings". Each of these wings had its own similar barrack and dining rooms (in permanent brick buildings), its own Service Institutes for use in leisure hours, and its own specially allotted sections of the large and airy workshops. Intermingling of the wings was, therefore, largely limited to open-air activities, with, to a smaller extent, some mixing off-duty and in a communal station cinema. The wings were themselves sub-divided into three "Squadrons", and these too, were fairly self-contained and separate units, though not so decisively separated as the wings. In general, this structure, coupled with a highly organized medical service and method of sickness recording, made it administratively possible, and indeed simple, to set up "experimental" groups to be compared with "control" groups, both groups being very similar in their characteristics and conditions of life, but living and working largely apart.

The apprentices enter the service, usually direct from school, between the ages of 15½ and 17 in thrice-yearly entries; and they remain on the station for 3 years. Their health is good and their height and weight gains during the 3 years equal to, or better than, the average of youths in other occupations (Morant, 1949). The station was organized as a school with three terms per year, each with a short mid-term break, and holidays at the usual times but rather shorter than normal.

Procedure

In this setting it was decided to make a trial of impregnated handkerchiefs as a possible means of reducing the spread of upper respiratory infections.

Methods of Impregnation.—Dumbell, Lovelock, and Lowbury (1948) drew attention to the large number of airborne bacteria-carrying particles which were liberated by a handkerchief as normally used, and in a subsequent paper, Dumbell and Lovelock (1949) reported that handkerchiefs could be impregnated with various substances which would sterilize the nasal secretion deposited therein. The problem in the present trial was to find a practical method of impregnating handkerchiefs on a relatively large scale.

Solutions of hexyl resorcinol and of octyl cresol, emulsions of these substances, and direct application by a roller machine (not unlike a domestic mangle) were all tried and discarded: a reasonable consistency of impregnation allied to ease of application was eventually achieved by immersing handkerchiefs in a solution of octyl cresol in 60 per cent. alcohol. The handkerchiefs were then transferred to a very large bath of water, when most of the octyl cresol was retained in the cotton and only one-quarter to one-third was washed away with the alcohol. Impregnated in this way, handkerchiefs were found to reduce the numbers of particles carrying viable bacteria to an extent comparable with the handkerchiefs which Dumbell and Lovelock impregnated direct from alcoholic solution in their small-scale experiments. This method of impregnation was therefore adopted, although the calendering raised an unexpected difficulty in that the heated rollers caused the emission of an irritating vapour, the equivalent of a fairly effective tear gas, which almost incapacitated the operators. It was found essential for the operators to wear service anti-gas respirators—a tiresome procedure which clearly debars the use of octyl cresol on any large scale. In the present research it was in fact used in Trials I to IV.

At a later stage attention was turned to the use of glycollic acid when various new difficulties had to

be overcome. The technique employed with octyl cresol and described above was unsatisfactory owing to precipitations of calcium salts from previous laundering; but a small roller machine which had been tried before was used with some success. In this machine, rollers dipping in a trough of glycollic acid transferred the latter with reasonable consistency to the handkerchiefs. On the other hand calendering was even more difficult, for when impregnated with glycollic acid the handkerchiefs stuck to the cloths of the calender, were awkward to remove from its rollers, and frequently tore its cloths. Glycollic acid was also found to cause rapid deterioration of the material of the handkerchiefs, and this ultimately brought the trial to an end (Trial V). Throughout the trials a sample of handkerchiefs was taken from each batch after calendering for a test of the impregnation—to ensure that consistent amounts were being applied and that no undue build-up of the chemical was occurring. In addition a bacteriological check was made at intervals. It was found that neither of the chemicals was as bactericidal when used on a large scale in the ways described above as in the laboratory trials with a small number of handkerchiefs. Octyl cresol was particularly disappointing.

Distinctive handkerchiefs with brightly coloured borders were obtained especially for the trials. The leading apprentice in charge of each barrack room (with a maximum of twenty occupants) was made responsible for their collection and issue; but individuals could make personal exchanges at any time in cases of necessity.

RECORDS OF ILLNESS.—Records of attacks of upper respiratory disease came from two sources:—

(*a*) Attendances at the regular morning sick parade.

(*b*) Reports of attacks of the common cold which did not bring an apprentice to the sick parade but which he was specially instructed to report to the leading apprentice in charge of his barrack room.

Checks on these latter records were made throughout the trials by drawing at random a one per cent. sample of the population for interview. At these interviews the frequency of colds which had not been reported could be assessed. A 10 per cent. random sample of those reporting a cold was also drawn regularly to determine what was comprised by these self-diagnosed "colds".

The clinical diagnoses of upper respiratory complaints seen at the daily sick parade were divided into three groups:

(*i*) *Cold.*—The condition normally so called, characterized by sneezing, rhinorrhea and/or catarrh, lacrimation, etc., with or without pyrexia.

(*ii*) *Sore Throat.*—A symptomatic diagnosis embracing tonsillitis and pharyngitis.

(*iii*) *Influenza.*—A febrile condition without localizing signs but with general symptoms such as limb pains and weakness.

(*iv*) *Self-Diagnosed "Colds".*—These were separately tabulated.

RESULTS

TRIAL I (*March 6 to May 20, 1950*).—In the first trial handkerchiefs were issued to all 1,500 apprentices in the three wings. Those issued to one particular wing were impregnated with octyl cresol; the remainder were untreated. After 4–5 weeks on this basis and following the mid-term break, all handkerchiefs were collected. On re-issue a different wing received the impregnated handkerchiefs. Such changes were, of course, unknown to the apprentices.

While there was no evidence that the impregnation was having any appreciable effect upon the occurrence of upper respiratory disease, it was found that the scale of the trial was too large for close and adequate supervision, and this trial was, therefore, abandoned.

TRIAL II (*August 28, 1950, to April 14, 1951*).—Arising out of the experience of the first trial it was decided to issue handkerchiefs to one wing only. The three squadrons of this wing would form "experimental" and "control" units for comparison one with another and also to some extent, with the other wings to which no handkerchiefs had been issued. The squadrons of No. 3 wing were selected since they had between them a trade division which ensured a greater separation at work than was the case with the squadrons of the other wings.

Handkerchiefs issued to two squadrons were impregnated with octyl cresol, those to the other squadron were untreated. Four handkerchiefs were issued weekly to each apprentice, but any apprentice using up his allocation before the end of the week could obtain a fresh supply on a one-for-one basis by a personal visit to sick quarters. Frequent checks were made by irregular inspections to ensure that the issued handkerchiefs, and not others, were being used, and several talks on the value and importance of the trials were given to the whole wing.

The results of Trial II are given in Table I. They show no differences between the group incidence of the various respiratory infections. The two squadrons given handkerchiefs impregnated with

TABLE I

HANDKERCHIEF TRIAL II

AVERAGE WEEKLY INCIDENCE OF UPPER RESPIRATORY DISEASES FROM AUGUST 28, 1950, TO APRIL 14, 1951*

Unit	Average Population	Colds		Influenza		Sore Throats		Self-Reported Colds		Total Colds (Per cent.)	Special Handkerchiefs Issued
		%	No.	%	No.	%	No.	%	No.		
1 Wing (Control)	456	2·2	270	0·7	83	0·8	98	4·7	582	6·9	None
2 Wing (Control)	309	2·6	214	0·6	51	1·0	88	4·1	338	6·7	None
3 Wing											
"A" Sqdn (Control)	196	2·2	118	0·5	24	0·7	36	5·2	274	7·4	Not impregnated
"B" Sqdn (Trial)	185	2·0	101	0·6	31	0·7	33	3·3	165	5·3	Impregnated, Octyl cresol
"C" Sqdn (Trial)	210	2·7	154	1·2	64	0·8	45	7·1	402	9·8	Impregnated, Octyl cresol

* Excluding the Christmas holiday

octyl cresol had, taken together, an incidence rate of 2·4 per cent. for colds diagnosed at sick parade and 5·3 per cent. for self-reported colds. The corresponding rates for the "control" squadron were 2·2 per cent. and 5·2 per cent.

TRIAL III (*September 1, 1951, to April 5, 1952*).—Despite this negative result, and pending the development of other possible methods of control, a further trial of handkerchiefs impregnated with octyl cresol was set in train. In the autumn and winter 1951–52 they were issued to one squadron while a second squadron received untreated handkerchiefs. The comparison of their experiences, and those of Wing No. 2, is given in Table II. Once again no significant distinction between the trial and control groups was found.

TRIAL IV (*October 20, 1951, to April 5, 1952*).—Shortly after the start of Trial III a more comprehensive attempt was made to reduce the spread of upper respiratory infection. The aim was to close at the same time as many potential routes of spread as possible. If this "combined operation" should fail, then it would seem that further action towards the control of respiratory infections must await new knowledge of modes of spread and prevention. The potential routes taken into account and the means used to close them were as follows:

(*a*) Airborne infection in barrack rooms/Ultra violet irradiation of the air.

(*b*) Dustborne infection in barrack rooms/Oiling of floors and oil impregnation of bed-clothes and pyjamas.

(*c*) Direct droplet spread in barrack rooms/Screens between the beds.

(*d*) Infection from handkerchiefs/Impregnated handkerchiefs.

These measures were directed, it will be seen, mainly to the living accommodation. The workshops were too large and dispersed for any attempt at aerial control.

(*a*) *Ultra-Violet Lighting*.—Owing to the relatively low ceiling height specially modified lamps* were installed. The efficiency of the irradiation could not be tested by routine air sampling since the oiling of the floor and textiles might also be playing a part. A deliberate contamination of the air was therefore required. Experience indicated that a natural and reproducible contamination could be produced by a "spraying spit"—which phrase implies the assembling of a quantity of saliva in the mouth, and its dispersal by violent blowing out through partially closed lips

* Loaned by British Thomson-Houston Ltd.

TABLE II

HANDKERCHIEF TRIAL III

AVERAGE WEEKLY INCIDENCE OF UPPER RESPIRATORY DISEASES FROM AUGUST 27, 1951, TO APRIL 5, 1952*

Unit	Average Population	Colds		Influenza		Sore Throats		Self-Reported Colds		Total Colds (Per cent.)	Special Handkerchiefs Issued
		%	No.	%	No.	%	No.	%	No.		
2 Wing (Control)	560	2·3	386	0·12	20	0·6	108	4·2	701	6·5	None
3 Wing											
"A" Sqdn (Control)	184	1·4	78	0·04	2*	0·8	44	5·4	296	6·8	Not impregnated
"B" Sqdn (Trial)	142	1·6	70	0·09	4	0·6	27	7·3	310	8·9	Impregnated, Octyl cresol

* Excluding the Christmas holiday

(Bourdillon, Lidwell, and Lovelock, 1948). The intention was to assess the efficiency of the irradiation by the rate of diminution in the bacterial count in the air, rather than by any absolute count at a given moment. Following two such spraying spits into the upper air of a barrack room, in which all the windows had been shut, air samples were taken each alternate half-minute to measure the die-away rate of the total bacterial air count produced by the spit. Tests made before the beginning of term and at the mid-term break showed a much more rapid fall in bacterial count in the irradiated rooms. It was not possible to fit dummy lamps in the rooms which were not irradiated, and as an alternative imitation "chemical disinfection" was provided. Once weekly the control barrack rooms were sprayed with a preparation of pine oil which left a "disinfectant" odour.

(*b*) *Oiling of Textiles.*—The blankets, sheets, pillow-cases, and pyjamas of all the apprentices living in the test barrack blocks were oil impregnated according to the technique recommended by the Launderers' Research Association (Harwood and others, 1944) and under the supervision of a member of its staff. Blankets were impregnated in the vacation and expected to retain sufficient dust-laying power throughout the term. Sheets, pillow-cases, and pyjamas were washed and re-impregnated weekly. Special studies by Mr. T. Nash of the Central Public Health Laboratory, Colindale, showed that the desired oil content of the laundered articles was being obtained. A bacteriological test suggested by Dr. R. E. O. Williams was also employed: at intervals throughout the trial an open petri plate containing serum agar was drawn once across the blanket just below the pillow line and the total colony count made after 24 hours incubation was, on the average, less than half the count found with the unoiled blankets. The oiling of textiles was not detectable by feel or odour and therefore required no action in the control rooms.

(*c*) *Oiling of Floors.*—The floors were oiled once a week with a suitable oil issued for the purpose from the Station Stores. At the same time the control barrack blocks drew their normal floor polish from the Station Sick Quarters as "medicated" polish instead of from the usual source.

The "medication" consisted of stirring up the smooth surface of the polish. To check the dust-laying a special dust sampler was designed by Mr. T. Nash, this consisted of a device by which jets of air, puffed through a long handle by a rubber bulb, impinged on the floor and raised a small cloud of dust, part of which was trapped on an exposed Petri dish. A considerable laying of dust was found in the test barrack rooms.

(*d*) *Bed Screens.*—Ordinary portable hospital-type folding screens were used, consisting of fabric material hung on a wooden frame. They were some 5 ft. high and effectively screened the occupants of the beds from each other.

After these measures had been brought into operation, the general bacterial content of the room air was assessed by a Bourdillon spit sampler. Tests were made approximately once a week in treated and non-treated rooms chosen at random, all tests following immediately after the apprentices had left the rooms after the luncheon break. Both sets of rooms revealed low counts, and though the treated rooms had a consistently lower level the differences were slight. These low counts were probably due to the good natural ventilation of the rooms which measured 60 × 20 × 10½ ft. high, with large windows down both sides and at one end.

The results of these measures are shown in Table III. The only difference of any magnitude lies in the high incidence of self-reported colds in the squadron to which the battery of preventive measures was applied. In spite of "dummy" procedures with the controls it may well be that these apprentices were made more cold-conscious and more ready to report their ailments. The sick parade figures give the following rates for colds, sore throats, and influenza combined.

TABLE III

TRIAL IV

AVERAGE WEEKLY INCIDENCE OF UPPER RESPIRATORY DISEASES FROM OCTOBER 15, 1951, TO APRIL 5, 1952*

Unit	Average Population	Colds		Influenza		Sore Throats		Self-Reported Colds		Total Colds (Per cent.)	Special Procedures
		%	No.	%	No.	%	No.	%	No.		
2 Wing (Control)	559	2·4	313	0·2	20	0·8	101	4·5	584	6·9	None
3 Wing "A" Sqdn (Control)	188	1·5	64	0·05	2	1·0	43	5·5	239	7·0	No general air hygiene; untreated handkerchiefs
"C" Sqdn (Trial)	234	2·3	126	0·1	5	0·8	46	10·0	541	12·4	General air hygiene; impregnated handkerchiefs, Octyl cresol

* Excluding the Christmas holiday

"C" Squadron (general air hygiene and impregnated handkerchiefs) 3·2 per cent.;

"B" Squadron* (impregnated handkerchiefs only) 2·3 per cent.;

"A" Squadron (untreated handkerchiefs only) 2·5 per cent.

No. 2 Wing (nothing) 3·4 per cent.

TRIAL V (*August 24, 1952, to March 31, 1953*).—The final trial was of handkerchiefs impregnated with glycollic acid. Two handkerchiefs per week were issued to "C" Squadron which continued with the general air hygiene measures described above, and two untreated handkerchiefs were given to members of "A" Squadron. No. 2 Wing was also observed as a further but less efficient control group. Unfortunately the treated handkerchiefs deteriorated rapidly under the influence of glycollic acid and after 4 weeks the trial had to be abandoned. The issue of the impregnated handkerchiefs had coincided with the onset of an epidemic of influenza. The results of the trial are shown in Table IV.

This Table reveals no appreciable difference between the two squadrons in the incidence of illness diagnosed as influenza. "A" Squadron with untreated handkerchiefs had a rate of 2·4 per cent. during the "glycollic acid period" and a total rate of 2·58 per cent. between January 12 and March 28. "C" Squadron with treated handkerchiefs and general air hygiene had corresponding rates of 2·54 per cent. No. 2 Wing suffered more severely in the epidemic than either of the two squadrons in the trial (giving rates of 4·21 and 4·60 per cent.).

With sore throats there is also no convincing evidence of advantage to the squadron issued with impregnated handkerchiefs and given general air hygiene. During the "glycollic acid period" the two squadrons did not differ materially (nor statistically to a significant degree). The respective rates were 1·96 and 2·62 per cent. Subsequently the squadron with impregnated handkerchiefs had a relatively and significantly low rate of incidence, 0·55 to 1·32 per cent. It must be noted, however, that it had been in precisely the same position *before* the issue of impregnated handkerchiefs, when the rates were 0·35 and 1·13 per cent. Compared with No. 2 Wing the trial squadron had a similar incidence of sore throats before the issue of impregnated handkerchiefs, not significantly different during their issue, but significantly lower subsequently. This one difference is not very impressive.

* Figures from Table II which relates to almost the same period of time.

TABLE IV

AVERAGE WEEKLY INCIDENCE OF UPPER RESPIRATORY DISEASES (TRIAL V)

Period ..	PRE-GLYCOLLIC ACID								
Date ..	AUGUST 24, 1952, TO DECEMBER 6, 1952								
Unit	Average Population	Colds		Influenza		Sore Throat		Self-Reported Colds	
		%	No.	%	No.	%	No.	%	No.
2 Wing (Control)	595	0·84	75	0·01	1	0·39	35	5·04	450
3 Wing "A" Sqdn (Control)	242	0·74	27	0·06	2	1·13	41	7·95	289
"C" Sqdn (Trial)	263	0·86	34	—	—	0·35	14	9·84	388
Period ..	GLYCOLLIC ACID								
Date ..	JANUARY 12, 1953, TO FEBRUARY 7, 1953								
Unit	Average Population	Colds		Influenza		Sore Throat		Self-Reported Colds	
		%	No.	%	No.	%	No.	%	No.
2 Wing (Control)	599	2·54	61	4·21	101	2·46	59	6·67	160
3 Wing "A" Sqdn (Control)	239	3·56	34	2·40	23	2·62	25	13·91	133
"C" Sqdn (Trial)	256	1·37	14	2·54	26	1·96	20	19·25	197
Period ..	POST-GLYCOLLIC ACID								
Date ..	FEBRUARY 14, 1953, TO MARCH 31, 1953								
Unit	Average Population	Colds		Influenza		Sore Throat		Self-Reported Colds	
		%	No.	%	No.	%	No.	%	No.
2 Wing (Control)	655	0·65	30	0·39	18	2·12	97	4·78	219
3 Wing "A" Sqdn (Control)	238	0·54	9	0·18	3	1·32	22	5·10	85
"C" Sqdn (Trial)	258	0·28	5	—	—	0·44	8	4·43	80

With the common cold the position is perhaps a little more doubtful. Initially all three groups were very similar with rates of 0·84, 0·74 and 0·86 per cent. During the issue of impregnated handkerchiefs the rate in "C" Squadron was significantly lower than that of "A" Squadron and No. 2 Wing. In the "post-glycollic period" its rate remained lower though not to a significant degree. On the Other hand the incidence of self-reported colds was not very different between squadrons "A" and "C" except during the period of issue of handkerchiefs when it was higher in those with the treated handkerchiefs. The total incidence of "colds" in these two squadrons was therefore 8·7 and 10·7 per cent. in

the "pre-glycollic period", 17·5 and 20·6 per cent. in the "glycollic period", and 5·6 and 4·7 per cent. in the "post-glycollic period". There is clearly nothing very striking here, though the lower incidence of colds observed on sick parade may indicate a value in the impregnation by glycollic acid. A longer trial would be needed to substantiate it.

SUMMARY

(1) Field studies of possible methods of reducing the spread of upper respiratory diseases were carried out at an R.A.F. training station, the population and general setting of which were peculiarly suitable for strictly controlled trials.

(2) The impregnation of handkerchiefs with octyl cresol produced no lower incidence of upper respiratory disease in those using them compared with the incidence in those using untreated handkerchiefs.

(3) A trial combining sterilization of barrack room air by ultra-violet light, reduction of airborne bacteria by oiling floors and textiles, introduction of screens between beds, and the use of handkerchiefs impregnated with octyl cresol failed in this population to reduce the incidence of upper respiratory diseases.

(4) The same general measures together with the impregnation of handkerchiefs with glycollic acid produced no difference in the incidence of influenza and sore throats, but gave a somewhat lower incidence of the common cold. This calls for further trials.

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PSYCHIATRIC DISABILITY AND EMPLOYMENT

I. A SURVEY OF 222 REGISTERED DISABLED PERSONS

BY

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(1) INTRODUCTION

The social effects of neurosis no longer need to be stressed. This is especially true of occupation; the Disabled Persons (Employment) Act, 1944, is an outward sign of the common concern for the problems of the handicapped. It is generally assumed that psychiatric illness is particularly potent in damaging the capacity for work, and employers may turn men away for that reason. The previous work of this Unit has, however, largely failed to confirm this assumption (Markowe and Barber, 1952, 1953a, 1953b). These studies were concerned with men working in factories, of whom only a proportion had symptoms and all could be regarded, within broad limits, as adapted to their work.

The present investigation studied 222 men on the Disabled Persons Register with overt psychiatric disturbances. Subjects were selected because they had been heavily unemployed or else constantly employed over a certain period. The two groups were then compared in order to demonstrate that certain clinical features are associated with unsatisfactory employment records.

(2) PREVIOUS INVESTIGATIONS

Eisenberg and Lazarsfeld (1938) reviewed the psychological and social case-work studies on unemployed men and described the deterioration in morale which was observed in the unemployed Austrian village of Marienthal. They cited evidence that unemployed workers were more neurotic than employed men, and were more depressed about their future than neurotic patients (Morton, 1935; Israeli, 1935).

Lewis (1935) examined 52 men referred by the local Public Assistance Committee. He found a uniform clinical picture in which hysteria was predominant. Gross tremor was present in 23 patients and three showed a pseudo-dementia. Depression and irritability were common features, but not self-reproach, and there was much resentment and dissatisfaction, which however were described as a paranoiac reactive development of personality rather than as a paranoid delusional formation. In a follow-up one year later it was found that one-third of the men were no longer on out-relief and that many of the remainder were defective, epileptic, insane, elderly, or physically unfit.

Hewitt (1949) examined 50 unemployed disabled men, and found only seven free from psychiatric disability. He was impressed by their lack of interest in life and their pathological attitudes of resentment, aggression, and depression. In a follow-up one year later one-third had found employment, and Hewitt concluded that the attitude of mind of the disabled was the most important factor influencing employment.

In a follow-up of 103 patients discharged from the Belmont Industrial Neurosis Unit (Jones, 1952), those rated as having made a poor adjustment (including occupational adjustment) differed from the remainder in that more of them were single, had a long history of previous psychiatric illness, were more frequently unemployed before admission, and were more often diagnosed as schizophrenic or psychopathic. This confirms previous work (Stalker, 1945; Guttman and Thomas, 1946; Harris and Lane, 1949). Also reported (Jones, 1952) is a survey of psychiatrically disabled men with much unemployment, who had not been to Belmont. They were found to be disgruntled and embittered, in poorer health than the ex-patients, and with little hope for the future, either for work or for health. All these studies stress the importance of personality rather than psychiatric syndromes as a determinant of occupational adaptation.

(3) METHOD

The group of unemployed men studied in this investigation all had at least 6 months' unemployment during the years 1950–53, while the employed subjects had less than

3 months' unemployment during the same period. All subjects had been registered at Employment Exchanges in South London as suffering from psychiatric disability. All the 95 unemployed subjects chosen were interviewed, but the 127 employed men who were seen formed only 22 per cent. of a much larger group, who were approached but did not attend for interview.

Each subject was interviewed for an hour by a psychiatrist and as full a history as possible was taken along customary lines. At the end of the interview a five-point rating was made of the subject's mental health on the basis of the history and psychiatric examination.* A physical examination was made where indicated, and an ischaemia pain endurance test was also carried out (Markowe and Barber, 1953b). After the psychiatrist's interview the occupational history was taken and the subject's present economic position assessed. Finally, all subjects were asked to do the Dominoes Test of general intelligence and to complete the Cornell Medical Questionnaire. In addition to information obtained at the interview, data were obtained also from the files of the Employment Exchange and the central offices of the Ministry of National Insurance and Pensions and the National Assistance Board,† and from the records of hospitals attended by the subjects.

(4) Findings

Age.—The mean age of the 127 employed subjects was 42·43 years (S.D. = 11·83) and of the 95 unemployed 41·65 years (S.D. = 9·66). These means do not differ significantly. The age distribution does not differ significantly from that given for adult males in the 1951 Census Report for the County of London (General Register Office, 1953).

Diagnosis.—Table I sets out the diagnostic categories of the subjects.

Table I
DIAGNOSIS

Type of Disorder	Unemployed	Employed	Total
Affective disorder	25	67	92
Hysteria	8	11	19
Obsessional state	4	5	9
Involutional depression	2	8	10
Cerebral arteriosclerosis and organic deterioration	4	7	11
Schizophrenia	11	4	15
Inadequate personality	19	8	27
Gross emotional instability	7	1	8
Mental defect	14	10	24
G.P.I.	1	1	2
Parkinsonism	—	1	1
Epilepsy (without psychiatric complications)	—	2	2
Buerger's disease	—	1	1
Thyrotoxicosis (without psychiatric complications)	—	1	1
Totals	95	127	222

* The ratings were: (1) "sympton free"; (2) "a few minor symptoms only"; (3) "some symptoms present, but no disability"; (4) "handicapped and distressed; may be receiving treatment from G.P., but does not require specialist psychiatric treatment"; (5) "materially incapacitated; required specialist psychiatric treatment".

† Permission was obtained from all subjects for these files to be consulted.

(*a*) *Affective Disorder, Hysterical and Obsessional States.*—These diagnoses are equally represented amongst both employed and unemployed subjects, but many of the unemployed had either been ill for less than 3 years or else had a personality disturbance as a background to the illness (Table II). No type of personality disturbance was found more frequently amongst unemployed than employed subjects.

Table II
REVISED DIAGNOSTIC GROUPS AND EMPLOYMENT

Type of Disorder			Unemployed	Employed	Total
Affective hysterical and obsessional	Less than 3 years' duration		12	3	15
	More than 3 years' duration	Stable personalities	7	37	44
		Mildly disturbed personalities	18	43	61
Psychopathic	Inadequate personality; Gross emotional instability		26	9	35
Involutional	Depression; Cerebral arterio-sclerosis		6	15	21
Schizophrenic			11	4	15
Others (including mental defect)			15	16	31
Totals			95	127	222

$\chi^2 = 47{\cdot}8$; $P < 0{\cdot}001$ (6 d.f.)

Within the group of 105 subjects with more than 3 years' illness there is a clear association between severe mental ill-health and unemployment, which is statistically significant at the 0·1 per cent. level. There were eighty subjects in this group who were employed; of these subjects those who were improving in economic position were more often of stable personality and of better mental health, while those who were deteriorating in economic position were often of worse mental health with disturbed personalities. This last association was statistically significant at the 1 per cent. level.

(*b*) *Involutional Illnesses.*—In this group subjects with depression and those with organic deterioration may be classed together, for their problems of occupational adaptation are essentially the same. With the exception of one man aged 48 years, all the subjects were in the sixth and seventh decades, and showed the rigid personality pattern typical of such illnesses. Three-quarters of them were employed, and, although a number of them had been skilled workers, all were now employed in unexacting occupations: messenger, night-watchman,

lift attendant, door-keeper, etc. Of the six who were unemployed, three were considered to be too ill to work: one had only recently been discharged from hospital and had probably not yet had time to find a suitable job, one was pensioned off and could not therefore be regarded as still part of the labour force, and information was lacking for the sixth.

(*c*) *Schizophrenia.*—Only four of these fifteen subjects were employed. Three of them had been discharged from hospital for over 5 years, and could be regarded as much improved. There were no signs of active schizophrenic illness in any of them, and they were all employed in unexacting occupations. The fourth, who had a mild chronic paraphrenic illness, had never been treated, and maintained a precarious and eccentric adjustment as labourer in a confectionery factory, where he held Bible meetings in the lunch-hour breaks. The personalities of all four were relatively well-preserved. Of those who were unemployed, four were ill, exhibiting frank schizophrenic psychopathology, and in need of treatment, six had a chronic illness with deterioration and schizophrenic personality defects, although the illness was no longer active, and one had only recently been discharged from hospital.

(*d*) *Inadequate Personality.*—This diagnosis customarily leans heavily on the occupational history, but this is insufficient in a study which seeks to relate psychiatric illness and employment. The outstanding characteristic of these subjects was the inadequacy of their affective responses at the interview. The majority were unemployed, and the eight who were employed were in sheltered occupations, *e.g.* Remploy, Local Authority, hospitals. The impression was left that, although employed, these men were not in fact at work.

(*e*) *Emotional Instability.*—This was represented by a group of eight disturbed, difficult, and aggressive men. One man when interviewed roundly abused the authorities for not awarding him a pension, then admitted that he had not bothered to appeal against the tribunal's decision, and finally asked the investigator for a loan of £50. Another was under treatment for exhibitionism, and another had been sent to prison for forging his Post Office Savings Book. Only one man in this group was employed, and he was a clerk; it is to be noted that he was capable of more exacting work than the psychopaths of inadequate type in employment who were discussed in Section (*d*).

(*f*) *Mental Defect.*—24 subjects were diagnosed as being feeble-minded, and the outstanding finding is the age distribution. With three exceptions, all the ten employed defectives were under 35 years of age, and all the fourteen unemployed defectives were aged 35 years or older. Data obtained from the Ministry of Labour do not confirm this finding, which must therefore be considered unreliable.

(*g*) *Other Conditions.*—The employed subject with G.P.I. was very similar in many ways to the group of employed subjects with involutional illnesses, and he was employed as a hospital porter. The unemployed subject was much deteriorated. The remaining five, who were all employed, were of stable personality, and some were employed in spite of a considerable physical handicap. The subject with thyrotoxicosis, for example, also suffered from angina pectoris and intermittent claudication; he had had to give up a job as sales representative owing to his difficulty in travelling, and now earns a livelihood by typing at home.

Table II summarizes the clinical findings which are relevant to employment, and there is a statistically significant association between these clinical groups and employment. In this Table the two groups of psychopathies have been added together, and the two groups of involutional illnesses; this is considered justifiable as the employment behaviour of the added groups is very similar. Mental defect was not considered separately because it was not thought to be a reliable figure.

OTHER CLINICAL FEATURES.—Apart from diagnosis, the two groups of employed and unemployed subjects differed in other respects.* The following clinical features distinguished the unemployed: insomnia, loss of weight, hysterical conversion symptoms, ideas of reference, lack of irritability or aggressive outbursts, neglected appearance, disturbed mood, low or deteriorated intelligence (clinical estimate), presence of abnormal features in the mental state, lack of insight into the effect of their illness on their occupation, and greater attendance at out-patient clinics. They were more often suspicious or hostile at the interview, but only twelve of the unemployed and three of the employed showed any marked degree of resentment or hostility. In personality traits the unemployed tended to be immature, irresolute, lacking in social and personal responsibility, of shallow affect, and introverted. In the ischaemia pain endurance test the employed subjects complained sooner than did the unemployed. In all other clinical findings there was no significance difference between the two groups. In the Dominoes Test of general mental

* Unless otherwise stated, all the differences reported are statistically significant ($P < 0{\cdot}05$).

ability the mean score of employed subjects was significantly higher than that of the unemployed. This difference was still upheld when the schizophrenic, feedle-minded, and organic disease of cases were excluded. Neither the mental health ratings nor the Cornell Index differentiated significantly between the two groups.

PERSONAL AND SOCIAL DATA.—38 of the unemployed subjects were single men, 56 were married (including the twelve in which the marriage had been complicated by divorce or separation), and one was a widower. Of the employed 35 were single, 91 were married (including nine cases complicated by divorce or separation), and one was a widower. The higher proportion of single men amongst the unemployed is statistically significant when compared both with the employed and with the figures for London Administrative County (General Register Office, 1953).*

Further distinguishing features of the unemployed group were a disturbed or unhappy home atmosphere as a child, present marital unhappiness and domestic friction, deficient social interests and activities, and frequently a lack of service in the Forces. Few were receiving pensions.

There was a difference between employed and unemployed subjects in their attitude to their present economic position: the majority of the employed subjects either definitely liked their work or were actively looking for a change of job, but the majority of the unemployed subjects were not very disturbed about their unemployment, although they were not satisfied.

Registration had been advised by the Ministry of Labour or the subject's doctor in many cases, but 31 of the employed subjects and five of the unemployed had registered as Disabled at the request of their employers. This difference is significant. Only eighteen of the unemployed subjects and 26 of the employed had attended Government Training Centres or Industrial Rehabilitation Units or had been employed by Remploy.

OCCUPATIONS OF REGISTERED PSYCHIATRICALLY DISABLED.—It was expected that the majority of disabled persons would be employed under certain special conditions. These conditions include no direct loss to the employer from inefficiency, no active pressure from competitors, and employments where national policies concerning disabled persons have most influence; these employments tend also to be those where the tasks are not exacting to the same degree as those in industrial employment for competitive markets.

These conditions obtain in all forms of employment by public utilities, and local and central government, and over half the employed subjects are found in such employments (Table III). The

* It is of interest to note that the diagnoses of schizophrenia, psychopathy, and mental defect were made in nearly two-thirds of the unemployed single men.

TABLE III

COMPARISON OF PERCENTAGE DISTRIBUTIONS OF OCCUPATIONS OF REGISTERED PSYCHIATRICALLY DISABLED MEN

General Description	Categories of Workers Included	Total Unemployed (all interviewed)	Employed and Interviewed	Total Employed invited to Interview
Builders' Labourers	All types of unskilled workers in building construction, and decoration	17	1	18
Labourers	All general labourers	18	12	
Personal Service	Shop assistants, domestic workers	28	10	17
Factory Workers	Machine tenders and assembly factory workers			
Self-Employed	Engaged in running own shop, distribution and repairs, dealing, street vending, etc.	7	5	2
Clerks and Supervisors	All clerical workers, other than those in public employment	6	6	6
	Shop managers, foremen, chargehands, etc.			
Skilled Workers	Apprenticed and specially-trained workers, other then those in public employment	4	11	7
Employed in Public Utilities, Local and Central Government	All types of worker	16	55	50
No Job since 1950		4	—	—
Total		100	100	100

large difference between the proportion of employed and unemployed persons in these occupations also indicates that of disabled persons who are employed relatively few have fallen out of these employments. On the other hand, builders' labourers when disabled are particularly exposed to unemployment. The category of skilled workers shows exactly the opposite trend, for disabled persons when qualified and employed in their own crafts do not readily fall out of work.

Table III also shows that there is no material difference between employed subjects who volunteered to come for interview and those who did not. The difference between total employed and interviewed displayed in Categories 2 and 3 may be due to the precarious nature of employment, apprehension, and loss of earnings involved in coming for interview. That displayed in Categories 6 and 7 suggests that leave of absence could easily be obtained and may account for the slightly larger proportion among persons interviewed.

INCOME* AND FINANCIAL INCENTIVE TO RETURN TO WORK.—The comparisons in Table IV were made to discover whether the group of unemployed men differed in earning capacity when last in employment from the group of employed men. It will be seen that only the single men show a difference so large as to be clearly not due to changes in the value of money, or wage rates. This might support a contention that the unemployed single men are a differently constituted group from the employed single men (see Footnote on p. 42).

The financial incentive to return to work is indicated by the difference between the present income of the unemployed from all sources compared with the income obtained when last employed (Table IV). Most of the single men are however living with their parents, and, although regular payments were said to be made for board and lodging, in general such payments were excused if the parents or siblings were employed, and the financial incentive to return to work is correspondingly reduced for this group. Married men without dependants have therefore the highest incentive and in fact they form a smaller proportion of the unemployed than do single men or those with dependants (Table V).

* Includes family allowances, wife's earnings, etc.

TABLE V

PERCENTAGE DISTRIBUTION OF MARITAL STATUS OF UNEMPLOYED AND EMPLOYED REGISTERED PSYCHIATRICALLY DISABLED MEN

Marital Status	Unemployed	Employed
Married with Dependants	34	38
Married without Dependants ..	14	31
Single	52	31
Total	100	100

(5) DISCUSSION

Adaptation is probably specific for each group of occupations. Table III indicates the range of occupations encountered in this study. These findings are further restricted in significance by the failure of many of the employed men to attend for interview. Their refusals cannot be attributed to their occupations, which were similar to those of the employed men who volunteered (Table III), but were probably due to differences in personality or mental health. Only tentative conclusions can be reached therefore in this discussion.

CLINICAL FINDINGS.—Employed men tended to have rather higher wages and total income than those secured by the unemployed in their previous work. Failure to gain employment may therefore represent an acute episode in the chronic condition of lacking value in the labour market. Can such a condition be defined in psychiatric terms?

(*a*) *Type of Illness.*—The diagnosis does not seem to bear any special significance for occupational adaptation in these subjects, apart from the syndromes which imply particular types of personality structure or disorganization. In the previous investigation by Lewis (1935) a uniform clinical picture was observed in which hysteria was predominant, but this was not found in the present

TABLE IV

COMPARISON OF MODAL INCOMES (£), SHOWING FINANCIAL INCENTIVE TO RETURN TO WORK

Marital Status	Employed	Unemployed		Financial Incentive to Return to Work (2) — (3)
	Present Total Income (1)	Previous Total Income (2)	Present Total Income (3)	
Married with Dependants	9·2	8·3	6·0	2·3
Married without Dependants ..	10·0	9·0	4·8	4·2
Single	7·0	5·4	2·0	3·4

investigation. Moreover, gross hysterical features (tremor or pseudo-dementia) were found more frequently by Lewis than by the writers. The reasons for this difference are still far from clear, but it has been noted and discussed by other observers (Halliday, 1948).

(*b*) *Mental Health.*—There is evidence that a recent disturbance of mental health affects occupational adjustment adversely. It is uncertain however which is anterior in this relationship. It is likely, for example, that depression is a direct consequence of being without work; some of the unemployed have been seen again since the survey was made, and there has been an obvious lightening of mood in those who have found work. Further follow-up studies are needed to elucidate this problem, but it is already clear that unemployment and mental ill-health have an effect of mutual enhancement.

The ratings of mental health and the Cornell questionnaire provided no evidence to suppose that the unemployed men were, as a group, more severely ill than the employed. Although, therefore, mental health is one factor in occupational adjustment, it is plainly insufficient to account for all the findings.

(*c*) *Personality.*—The findings in this investigation leave small doubt that the occupational adaptation of these subjects is largely governed by quality of personality. The analysis of the ratings of personality traits indicates the qualities which engender poor adaptation, and this clearly reflects the finding that unemployment is heaviest in the groups of inadequate and unstable personalities, and in schizophrenia. Even in the neurotics who were employed, the economic position of those with disturbed personalities tended to deteriorate. Another aspect of the differences in personality between the employed and unemployed groups of subjects is to be seen in their attitude to their present economic position and in their poor use of leisure; it may be that these men are ineffectual in all their activities.

Such findings were adumbrated in previous investigations, although in this respect there is an interesting discrepancy: bitter and resentful attitudes were not often found during the present study. This is not easy to explain: for the unemployed the world is patently a different place now from what it was when Lewis first made his observations in 1931, yet the "welfare state" had failed to assuage the bitterness of the control group of disabled men reported by Jones (1952), or of the disabled men examined by Hewitt (1949).

It is easier to talk about "personality traits" than to define them. At best they are illuminating inferences from observed behaviour, and they may be much less than that. Moreover, the separation of "personality" from "mental health" is at times arbitrary, as in the diagnosis of psychopathic personality, so that a more accurate statement would be that in the subjects investigated the permanent characteristics of a person's behaviour—revealed both in the history and on psychiatric examination—are of the first importance in determining the subject's occupational adjustment.

Socio-Economic Findings.—The most important fact arising from the socio-economic findings is the difference in the levels of financial incentive offered to the three groups of men (married with dependants, married without dependants, and single). As the earning potential of the unemployed person decreases, so the financial incentive to resume work also tends to decrease in effectiveness, even to the extent that among those having the lowest earnings when employed the adjustment of choice might be a state of unemployment. The work records of the unemployed often show a surprising degree of familiarity with the regulations and conditions governing the payment of benefits of all types, and betray a skill in manipulating these regulations which in itself represents a high degree of "adaptation".

Rehabilitation.—Two separate problems seem to be involved. Men with stable or well-preserved personalities, especially those who have only recently fallen ill, merit the maximum attention from those responsible for resettlement. Such men are likely to return to industry as efficient workers regardless of diagnosis, and it is possible that the period of total disablement could be reduced. The re-employment of men with inadequate personalities, however, may not amount to much more than a social service; the impression formed by the present investigators was that such men are not able to compete successfully with more productive workers. Careful assessment of personality is needed to obtain successful resettlement, and this requires closer co-operation between the doctor and the disablement resettlement officer than can be obtained from the simple filling in of a form.

Summary

(1) 222 men, all registered as disabled persons through psychiatric conditions, were examined; 95 were unemployed and 127 employed.

(2) The clinical and social histories of the employed and unemployed men were contrasted and compared.

(3) The following tentative conclusions were reached:

(*a*) Occupational adaptation is primarily determined by the personality of the subject.

(*b*) The subject's occupational adaptation is adversely affected by recent disturbances of the mental state, but not so much as by disturbances of the personality.

(*c*) The type of mental disorder is without significance for occupational adaptation unless it also implies a serious personality disturbance.

(*d*) Subjects who can earn only low wages have little or no financial incentive to regain employment.

(4) Successful rehabilitation of the psychiatrically disabled largely turns on whether the worker previously had a stable personality and a satisfactory work record.

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PSYCHIATRIC DISABILITY AND EMPLOYMENT

II. A FOLLOW-UP OF 95 UNEMPLOYED SUBJECTS

BY

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Since the survey, described in the first part of this paper, was made, the work records of the 95 unemployed subjects have been followed up over 12 months. Nine subjects were discarded (two died, two had retired, one was no longer registered as disabled, and four had left the area), and 86 remained.

At the end of the follow-up period 42 subjects were employed, but as the length of time employed varied considerably, it was thought that a more satisfactory index of unemployment would be the number of weeks for which unemployment or sick benefit had been claimed.

The results of the survey had suggested that a recent onset of a neurosis hindered successful adaptation, and it might therefore be expected that with the passage of time the number of weeks of unemployment and sickness would be less for these subjects than with those with more chronic illnesses; a further hypothesis drawn from the previous results was that subjects with a stable personality would also have better records than others. Table I was drawn up to test these hypotheses, giving the average number of weeks of unemployment and sickness for these two groups during the follow-up period.

TABLE I

AVERAGE RECORD OF UNEMPLOYMENT OR SICKNESS OF NEUROTIC SUBJECTS

Diagnosis	Number of Cases	Average Number of Weeks Unemployed or Sick
Recent Neurosis ..	10	23·4
Chronic Neurosis (stable personality)	7	28·9
Remainder	69	37·1
Total	86	29·8

As predicted, these two groups of subjects had less time off work than the remainder, but only in those with recent neurosis did the difference reach a statistical level of significance ($t = 2{\cdot}17$; $P < 0{\cdot}05 > 0{\cdot}02$). An examination of the work records for the 12 months before the follow-up period showed no difference between the various diagnostic groups.

A further comparison of the number of weeks off work between the follow-up period and the preceding 12 months demonstrated that all groups had shown a material improvement, except the mental defectives and those suffering from involutional conditions (Table II).

TABLE II

COMPARISON OF RECORDS OF UNEMPLOYMENT OR SICKNESS OF THE PERIOD 1952–53 WITH THOSE OF 1953–54 IN SUBJECTS WITH MENTAL DEFICIENCY AND INVOLUTIONAL CONDITIONS

Diagnosis	Number of Cases	Average Number of Weeks Unemployed or Sick	
		1952–53	1953–54
Mental Defect ..	12	49·0	44·8
Involutional Conditions	5	34·0	40·2
Remainder	69	42·4	32·7
Total	86	41·8	39·2

The decrease in time off work for the remainder is statistically significant ($t = 3{\cdot}79$; $P < 0{\cdot}001$).

A total of 25 subjects asked permission to attend a clinic which had been specially set up to deal with the problems of the psychiatrically disabled unemployed.

The average age of these 25 subjects was 5 years higher than that of those not attending the clinic,* and more of them had been rated at the time of the Survey as being of poor mental health, but they did not differ from the non-attenders in ratings previously obtained of personality traits. It was hoped that the subjects attending the clinic would show a greater improvement than a control group of non-attenders, equivalent in age, diagnosis, and mental health, and with similar personality ratings, but this was not the case (Table III, opposite). Neither the improvement shown by the two groups nor the differences between them reach a statistical level of significance.

The services performed by the clinic were of four kinds. Five subjects were referred for in-patient treatment; one of these was the only subject with an involutional condition who improved. Psychotherapeutic support was available to all patients.

* All these differences were statistically significant ($P < 0{\cdot}05$).

TABLE III

COMPARISON OF RECORDS OF UNEMPLOYMENT OR SICKNESS OF THE PERIOD 1952–53 WITH THOSE OF 1953–54 IN PATIENTS ATTENDING CLINIC AND A CONTROL GROUP

Group	Number of Cases	Average Number of Weeks Unemployed or Sick	
		1952–53	1953–54
Attending Clinic ..	25	46·4	42·16
Control	25	40·24	36·76

A few were helped by arranging a more satisfactory way of life; for example, an old man was found a place in an old persons' home. The main work of the clinic, however, lay in the advice offered on the social problems of the patients. One man, an undischarged bankrupt, was enabled to start in business again; another, crippled with many heavy debts, managed after encouragement to satisfy a Court Order. In spite of National Assistance, there were a few who lacked necessary clothing, etc., and they were very grateful for being put in touch with appropriate charities who could help them.

Much was also learned from patients who could not be helped. One man, aged 39, unmarried, was diagnosed as an inadequate psychopath with paranoid trends. After submitting him to several employers without success, out-patient occupational therapy was arranged. This attempt at social rehabilitation proved too much for him, and a paranoid psychosis developed with auditory hallucinations. For him, at the present stage of his illness, as for other "eccentric" members of the community, fuller social participation may be intolerable.

Finally, when patients were successful in regaining employment, this was only done through the closest co-operation with the disablement resettlement officers of the local employment exchanges, following the advice of Harris and Lane (1949).

DISCUSSION

This follow-up study provides further evidence that although the recent onset of a neurotic illness may produce unemployment it can be expected that in time the work record of such men will show a marked improvement.

The increase in employment shown by many of the subjects is an interesting feature. This may reflect the rise in the national figures for employment which occurred over the same period; it may in part be a response to the regulations which govern unemployment insurance, and require a period of 13 weeks' employment before benefits may be claimed. Lewis (1935) found that one-third of his patients were employed a year later, but the opportunities for employment are now so changed that it would be profitless to pursue the comparison further.

It is noteworthy that three groups of subjects did not share this increase in employment. The steady unemployment of the mental defectives confirms the findings of previous investigators. No doubt for the subjects with involutional conditions, age and illness were handicaps which together proved insuperable. The patients attending the clinic, however, formed a third group who, by their occupational records, showed themselves to be insensitive to economic pressure. The part played by their greater age need not be discussed further; the outstanding finding is their deterioration in mental health. Their increased time off work was not due to sickness absence rather than unemployment, as the proportion of certified sickness to total time lost (12 per cent.) was less than in those who did not attend the clinic. In this group of men marginally employed, sickness more often brings unemployment than in the employed men seen during the survey who could command a high value on the labour market.

While it would seem that the clinic was attended for the most part by those in gravest difficulties, social or psychiatric, their lack of improvement indicates that more vigorous measures are needed to bring about their rehabilitation. For some of them perhaps, as with the psychopath already quoted, attempts at rehabilitation are ill-advised. What the clinic did provide, and this was suggested in the discussion on rehabilitation in the first section of this paper, was a social service, needed and appreciated by the unemployed who were unprovided for by the Welfare Services of the State.

SUMMARY

(1) Ninety-five unemployed subjects, registered as psychiatrically disabled, were followed up for 12 months. All showed an improvement in their work record compared with that of the previous 12 months, except mental defectives and those suffering from involutional conditions and those previously rated as of poor mental health. The improvement was most marked in those with a neurosis of recent onset.

(2) Subjects who volunteered to attend a special clinic were more ill than the others, and failed to show improvement during the follow-up period.

(3) It is concluded that sickness is a greater deterrent to employment in those who are marginally employed than in those with good work records, and that measures more vigorous than out-patient treatment are needed to secure their rehabilitation.

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INCIDENCE OF MINOR MALADIES AND THEIR RELATIONSHIP TO INTELLIGENCE IN SCHOOL CHILDREN

BY

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This paper is based on the records of medical consultations over a period of one school year at a War Office sponsored boarding school situated in northern Germany. The school, which catered for some 650 children aged 11 to 18 years whose intelligence varied between wide limits, provided boarding accommodation for both sexes. The pupils were drawn from British Forces families in Germany. No differentiation in living conditions was made at this school between dull or bright children. The boarding houses were basically similar and provided a high degree of comfort. Most dormitories contained two to four beds and were centrally heated. Toilet facilities were good with adequate showers and baths and constant hot water.

The school meals were well planned, adequate in amount, and supervised by teachers who saw that all children had a normal varied diet. Clothing for all children conformed to minimum requirements stipulated by the school. Soiled clothes were laundered once weekly and house matrons ensured that they were kept clean and mended. The teaching staff actively encouraged the children to maintain a high standard of personal cleanliness. They were also quick to notice any ailing child who was promptly sent to see the doctor.

In short, the environment for the pupils whilst at school was uniform and its effect on the differences in disease rates was therefore minimized.

The medical staff consisted of one whole-time medical officer, one hospital matron, and four nurses. All routine treatments to ambulant patients were given in the medical centre. The school hospital had eighteen beds and was designed to deal with short-stay patients. Serious cases were sent to the nearest British Forces hospital.

Every effort was made to prevent attendance at the medical centre being used as an excuse for absenteeism. Consulting and treatment times were held at the centre outside normal school hours and any child detained there was given a note for the teacher stating the time of dismissal.

For the period under review (September, 1953, to July, 1954) a treatment record card was kept for every child attending the medical centre. Each consultation was noted on the card and new cases were entered in a disease group index. The entries on the cards were those dealing with everyday illnesses and did not include routine medical examination findings. Patients requiring treatment in bed were admitted to the school hospital and their particulars and case summaries were recorded in the admission register.

The children were divided into two groups according as their Intelligence Quotients (I.Q.) were less or greater than 110. This figure was chosen in order to give groups comparable with secondary modern school and grammar school pupils in England. The numbers in each group were sufficiently close to permit a comparative study.

Mental testing was carried out by means of the Moray House tests taken at the age of 11 years. The results were available for the majority of children and the remainder were classified by being given an advanced test or being interviewed by a teacher panel.

It has been found that the group intelligence tests give results comparable with those obtained by the Termanized-Binet test (Moray House test series). Previous work (Terman, 1921) showed that the I.Q. for a given child remained remarkably constant, and re-tests during periods of from 2 to 7 years gave similar results. For the purpose of this study the composition of each group was taken to be constant except for minor variations due to school leavers and new entrants.

At the beginning of each term a census was taken of all children in attendance in order to minimize the effect of changes in the school population on the calculation of rates per hundred.

Table I shows the average composition of each group.

TABLE I

NUMBERS OF CHILDREN ATTENDING SCHOOL

Term	No. of Children	
	I.Q. below 110	I.Q. 110 or over
Autumn	342	286
Spring	335	292
Summer	343	302
Mean..	340	293

DISEASE INCIDENCE

The causes of illness are listed in Table II which is self-explanatory except that the groups headed "upper respiratory tract infections", "other skin disorders", and "stress" warrant further clarification:

(1) *Upper Respiratory Tract Infections.*—These included colds, sore throat, laryngitis, and bronchitis. Cases with pyrexia were admitted to the school hospital for treatment. Other cases were treated as out-patients.

(2) *Other Skin Disorders.*—These included such conditions as warts, allergic dermatitis, hyperhydrosis, and fungus infections other than athlete's foot.

TABLE II

INCIDENCE OF ILLNESS ACCORDING TO INTELLIGENCE

Disease Group	Total Illnesses		Children			
			I.Q. below 110		I.Q. 110 or over	
	Number	Per cent. of Total	No. of Illnesses	Rate per 100	No. of Illnesses	Rate per 100
Upper Respiratory Tract Infections ..	768	35·2	491	144·4	277	94·4
Sprains and Bruises ..	380	17·4	229	67·4	151	51·5
Pyogenic Skin Infections ..	309	14·2	225	66·2	84	28·7
Miscellaneous ..	185	8·5	104	30·6	81	27·6
Other Skin Disorders ..	157	7·2	80	23·5	77	26·3
Wounds ..	123	5·6	87	25·6	36	12·3
Athlete's Foot ..	107	4·9	59	17·4	48	16·4
Stress	56	2·6	27	7·9	29	9·9
Mosquito Bites	41	1·9	24	7·1	17	5·8
Middle Ear Disease ..	32	1·5	19	5·6	13	4·4
Chickenpox ..	25	1·1	14	4·1	11	3·8

(3) *Stress.*—This included cases of "home-sickness". The majority of such cases occurred during the first 3 weeks of term and those affected were mainly new entrants. The presenting symptoms were general malaise, nausea, and abdominal pain in that order of importance. Clinical examination revealed no abnormality and recovery was invariably rapid, aided by rest in the school hospital and play therapy.

The results show that upper respiratory tract infections, skin diseases (pyogenic skin infections, athlete's foot, and other skin disorders), and trauma (sprains, bruises, and wounds) accounted for 84·5 per cent. of all minor maladies occurring in this age group of 11 to 18 years. Although not indicated in Table II, serious illness played a small part as a cause of ill-health. The number of cases sent to hospital amounted to 32 in the period under review, only 1·4 per cent. of all causes of sickness.

Table II shows that in four important causes of ill-health (upper respiratory tract infections, sprains and bruises, pyogenic skin infections, and wounds) differences in the disease rates were found in the two intelligence groups.

DISCUSSION

Disease incidence and intelligence have been studied previously (Dawson, 1931) by evaluating the I.Q. of child hospital in-patients and comparing the mean value with that of a large section of the child population. No relationship was found, there being no significant difference in the mean I.Q. values. Similarly, a study of the common infectious fevers (England, 1936) showed no difference in incidence between various intelligence groups. Other workers, however, detected a slight relationship between health and intelligence and a physiological link was suggested between these two qualities (Pearson, 1923).

The present study is concerned only with those causes of ill-health which are, in the main, dealt with by the family doctor or the mother. It is interesting to note that variations in incidence occurred in the very minor maladies, and that as the severity of the infection increased, the rates became more nearly equal.

The differences in the rates of incidence of sprains and bruises and wounds could have been due to lack of skill, but may have been influenced by the fact that children of lower intelligence followed a practical course of study, so that their exposure to the risk of such accidents was greater. Such a factor played no part in upper respiratory tract and pyogenic skin infections.

Conclusion

In school children aged 11 to 18 years, enjoying a uniform environment, the most common causes of ill-health were upper respiratory tract infections, skin diseases (pyogenic skin infections, athlete's foot, and other skin disorders), and trauma (sprains, bruises, and wounds).

Upper respiratory tract infections, sprains and bruises, pyogenic skin infections, and wounds were found to be more prevalent in the less intelligent children. The explanation for these findings is obscure.

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MATERNAL AGE AND BIRTH RANK IN THE AETIOLOGY OF MONGOLISM

BY

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The incidence of mongolism increases so remarkably with advancing maternal age that it hardly seemed necessary to earlier workers to know the maternal age structure of the population from which their cases were drawn (Shuttleworth, 1909; Brousseau, 1928; Engler, 1949), or to ensure that the control group was representative (Jenkins, 1933; Rosanoff and Handy, 1934; Lahdensuu, 1937; Bleyer, 1938; Benda and others, 1943; Beall and Stanton, 1945). These precautions were not neglected by Carter and MacCarthy (1951), who used a series of hospital births to establish firmly the relationship between incidence and maternal age.

Association with birth rank has been studied with less satisfactory results. Conflicting opinions have been expressed by investigators who did not have access to a satisfactory control group (Shuttleworth, 1909; Brousseau, 1928; Murphy, 1936; Bleyer, 1938; Beidleman, 1945), and the need first to eliminate the effect of maternal age has usually been overlooked. Examination of the separate effect of birth rank has rarely been attempted. Malzberg (1950) used the Greenwood-Yule method to investigate the influence of birth rank at each maternal age group, but his results are misleading since many of the unaffected sibs were born outside the maternal age range under consideration. A more acceptable adaptation of the Greenwood-Yule method designed to remove the influence of maternal age was used by Penrose (1934), who found that the risk of mongolism in first-born was slightly raised although the result was not statistically significant. He recognized that the method may give false results if applied to incomplete sibships, and avoided this error by selecting cases some years after birth when most of the fraternities were probably complete. This manoeuvre may be equally misleading as a result of the high early mortality of mongols. In a previous communication (Record and Smith, 1955) it was noted that the usual cause of death is infectious disease. In view of the marked increase in infant mortality from infection with birth order (Gibson and McKeown, 1952), it would be expected that a series collected some years after birth would show a deficiency in the later birth ranks. Mortality is greater for female than for male mongols, and the increase in the proportion of males with increasing birth rank exhibited by Penrose's series is consistent with this interpretation. The demonstration by Øster (1953) of an excess of mongols at the lower birth ranks, compared with normal infants born to mothers of the same age, may have a similar explanation since his observations were confined to mongols alive at the time of the inquiry.

It appears therefore that the question whether birth order is of aetiological importance in mongolism has not been satisfactorily answered. In an attempt to explore this problem we have collected data on a substantial series of mongols most of which were ascertained soon after birth, and on a control group representative of the population of births from which the affected subjects were drawn.

MATERIAL

An attempt was made to obtain information about all mongols born during the years 1942 to 1952 to mothers normally resident in the city of Birmingham. Sources of ascertainment have been described previously (Record and Smith, 1955). 252 cases were recorded, of which 217 were traced and the mothers interviewed in their homes. Of the remainder, three mothers refused to co-operate, and 32 either had left the city or had removed and were not traced.

A control series of 1,156 births, representative of the population of births from which the affected subjects were drawn, was obtained by taking every 200th entry from the birth notification records of the Maternity and Child Welfare Department. Controls had previously been assembled for the years 1942 to 1949 (McKeown,

MacMahon, and Record, 1951); the series was completed by the addition of births for the years 1950 to 1952.

The maternal age of the controls was given in birth notification records; birth rank (estimated from the number of previous live births and stillbirths, abortions being excluded) was derived from the same source. The maternal age at birth of the mongols was obtained in 217 cases at interview, and was available from the source of ascertainment in a further 24. The birth rank of the mongols was accepted only for the cases interviewed, since it was noted that the interpretation of the term in the recorded material was inconsistent, and that the information about stillbirths was sometimes incomplete. Maternal age was satisfactorily recorded in respect of 241 of the original 252 affected, and birth rank in respect of 217.

Results

Table I gives distributions of 241 mongols and 1,156 controls according to maternal age at birth. The incidence of mongolism in each maternal age group has been estimated by using the age distribution of controls to calculate the age distribution of the population of births from which the affected were drawn. It shows the usual well-marked increase as maternal age increases.

TABLE I
INCIDENCE ACCORDING TO MATERNAL AGE

Maternal Age (yrs)	Number of Mongols	Number of Controls	Incidence of Mongols (per 1,000 related births)
15–19	3	49	0·31
20–24	17	278	0·31
25–29	37	355	0·52
30–34	44	273	0·80
35–39	65	151	2·15
40–44	67	46	7·27
45–49	8	4	9·99
Total ..	241	1,156	1·04

Similar observations are given for each birth rank in Table II. As would be expected, the incidence of mongolism also increases with birth rank.

TABLE II
INCIDENCE ACCORDING TO BIRTH RANK

Birth Rank	Number of Mongols	Number of Controls	Incidence of Mongols (per 1,000 related births)
1	61	397	0·77
2	50	376	0·67
3	34	174	0·98
4	26	98	1·32
5 and over	46	111	2·07
Total ..	217	1,156	0·94

The effects of maternal age and birth rank are separated by examining the distributions of mongols and controls according to maternal age at each birth rank (Table III) and according to birth rank at each maternal age group (Table IV). The results leave little doubt that association with maternal age is almost independent of birth rank, and that association with birth rank is largely eliminated when the influence of maternal age is removed. There is, however, an excess of mongols in the first birth rank at all maternal ages except "40 and over".

TABLE III
DISTRIBUTIONS BY MATERNAL AGE AT EACH BIRTH RANK

Birth Rank	Maternal Age (yrs)	Mongols		Controls	
		Number	Per cent.	Number	Per cent.
1	15–19	2	3·3	40	10·1
	20–24	9	14·8	160	40·3
	25–29	17	27·9	126	31·7
	30–34	16	26·2	46	11·6
	35–39	12	19·7	20	5·0
	40 and over	5	8·2	5	1·3
	Total ..	61	100	397	100
2	15–19	—	—	8	2·1
	20–24	3	6·0	91	24·2
	25–29	8	16·0	133	35·4
	30–34	12	24·0	93	24·7
	35–39	16	32·0	44	11·7
	40 and over	11	22·0	7	1·9
	Total ..	50	100	376	100
3	15–19	—	—	1	0·6
	20–24	—	—	25	14·4
	25–29	7	20·6	54	31·0
	30–34	4	11·8	66	37·9
	35–39	9	26·5	21	12·1
	40 and over	14	41·2	7	4·0
	Total ..	34	100	174	100
4	20–24	—	—	2	2·0
	25–29	3	11·5	29	29·6
	30–34	7	26·9	33	33·7
	35–39	8	30·8	27	27·6
	40 and over	8	30·8	7	7·1
	Total ..	26	100	98	100
5 and over	25–29	1	2·2	13	11·7
	30–34	1	2·2	35	31·5
	35–39	14	30·4	39	35·1
	40 and over	30	65·2	24	21·6
	Total ..	46	100	111	100
All Ranks, All Ages ..		217		1,156	

These points are considered in Tables V and VI (opposite). Table V shows the expected numbers of mongols at each age group estimated by a process of standardization designed to eliminate the effect of differences in birth rank distribution between mongols and controls. A significance test confirms the impression obtained from Table III, that the association between incidence and maternal age cannot be explained by differences in birth rank. Using a similar method to eliminate the effect of maternal age, it is shown (Table VI) that the association with birth rank is much less marked, but that in the first birth rank there is a significant excess of mongols.

TABLE IV

DISTRIBUTIONS BY BIRTH RANK AT EACH MATERNAL AGE

Maternal Age (yrs)	Birth Rank	Mongols		Controls	
		Number	Per cent.	Number	Per cent.
15–19	1	2	100·0	40	81·6
	2	—	—	8	16·3
	3	—	—	1	2·0
	Total ..	2	100	49	100
20–24	1	9	75·0	160	57·6
	2	3	25·0	91	32·7
	3	—	—	25	9·0
	4	—	—	2	0·7
	Total ..	12	100	278	100
25–29	1	17	47·2	126	35·5
	2	8	22·2	133	37·5
	3	7	19·4	54	15·2
	4	3	8·3	29	8·2
	5 and over	1	2·8	13	3·7
	Total ..	36	100	355	100
30–34	1	16	40·0	46	16·8
	2	12	30·0	93	34·1
	3	4	10·0	66	24·2
	4	7	17·5	33	12·1
	5 and over	1	2·5	35	12·8
	Total ..	40	100	273	100
35–39	1	12	20·3	20	13·2
	2	16	27·1	44	29·1
	3	9	15·3	21	13·9
	4	8	13·6	27	17·9
	5 and over	14	23·9	39	25·8
	Total ..	59	100	151	100
40 and over	1	5	7·4	5	10·0
	2	11	16·2	7	14·0
	3	14	20·6	7	14·0
	4	8	11·8	7	14·0
	5 and over	30	44·1	24	48·0
	Total ..	68	100	50	100
All Ages, All Ranks ..		217		1,156	

TABLE V

OBSERVED AND EXPECTED DISTRIBUTIONS OF MONGOLS ACCORDING TO MATERNAL AGE

Maternal Age (yrs)	Number Observed (*a*)	Number Expected* (*b*)	Difference (*b*) − (*a*)
15–19	2	7·4	+ 5·4
20–24	12	42·1	+ 30·1
25–29	36	60·7	+ 24·7
30–34	40	55·6	+ 15·6
35–39	59	36·3	− 22·7
40 and over	68	14·9	− 53·1
Total ..	217	217	—

$\chi^2 = 149·6$; $n = 5$; $p < 0·0001$

* For method of calculating expected values see text.

We now inquire whether the effect of primogeniture may be accounted for by defects in the data. Three possible sources of error may be considered:

(1) The representation of first-born in the control group may be deficient. This possibility was examined in a previous communication (McKeown, MacMahon, and Record, 1951) and reasons were given for believing that the control group then available (for 1942–49) was representative of Birmingham births although it showed a lower proportion of first-born than the Midland I Region. Comparison between the control group used in the present study (1942–52) with the Registrar-General's estimate for the Midland region for the period 1942–51 (the relevant statistics for 1952 are not published) again shows a deficiency of first-born in the control group. Part of the difference is due to our recognition of previous stillbirths as well as live births in calculating birth rank, whereas the Registrar-General restricts attention to previous live-born children. If the birth rank of mongols is adjusted by ignoring previous stillbirths, comparison with the Midland region by the method used in Table VI still shows a primogeniture effect (for one degree of freedom, $\chi^2 = 3·85$; $p = 0·05$).

TABLE VI

OBSERVED AND EXPECTED DISTRIBUTIONS OF MONGOLS ACCORDING TO BIRTH RANK

Birth Rank	Number Observed (*a*)	Number Expected (*b*)	Difference (*b*) − (*a*)
1	61	42·7	− 18·3
2	50	58·1	+ 8·1
3	34	34·0	0·0
4	26	27·9	+ 1·9
5 and over	46	54·3	+ 8·3
Total ..	217	217	—

Comparing Birth Rank 1 with 2 and over: $\chi^2 = 7·91$; $n = 1$; $p = 0·005$.

(2) The birth rank distribution of the 217 traced cases may differ from that of the 252 mongols identified. The effect of incomplete tracing was investigated in an earlier inquiry (Record and McKeown, 1949), in which it was shown that the proportion of first-born was less for interviewed cases than for those not found. Any error from this source would reduce rather than give rise to a primogeniture effect.

(3) The methods used in assembling the mongol series may favour identification of first-born. The observation that ascertainment of cases was more complete for hospital births than for domiciliary births (Record and Smith, 1955) combined with the fact that hospital deliveries are weighted in favour of primiparae gives some support for this possibility. That it is not the explanation for the primogeniture effect is readily shown by dividing mongols and controls according to place of birth and repeating the analysis (Table VII, overleaf). The excess of cases in the first birth rank is marked for subjects born in hospital, but much less so for those born at home.

An explanation of this difference according to place of birth may be found in the influence of birth rank on mortality (Table VIII, overleaf). Numbers are small, but the figures suggest that mortality rates for first-born in the age period 14 days to 1 year are not influenced by place of birth; before the age of 14 days however, mongols born in hospital show a considerable mortality, but no deaths were recorded among the

TABLE VII

OBSERVED AND EXPECTED DISTRIBUTIONS OF MONGOLS ACCORDING TO BIRTH RANK AND PLACE OF BIRTH

Place of Birth	Hospital		Home and Nursing Home	
Birth Rank	1	2 and over	1	2 and over
Expected Number (*a*) ..	45	56	16	100
Observed Number (*b*) ..	31·9	69·1	14·0	102·0
Difference (*b*) − (*a*) ..	−13·1	+13·1	− 2·0	+ 2·0
χ^2 ($n = 1$)	6·33 $p = 0·01$		0·27 $p = 0·60$	

TABLE VIII

MORTALITY RATES (PER CENT.) OF MONGOLS

Birth Rank	Place of Birth	Age at Death	
		Under 14 days	14 days to 1 year
1	Hospital ..	28·9 (45) } 21·3 (61)	25·0 (32) } 25·0 (48)
	Home	0·0 (16) }	25·0 (16) }
2 and over	Hospital ..	10·7 (56) } 11·5 (156)	26·0 (50) } 31·9 (138)
	Home	12·0 (100) }	35·2 (88) }

Numbers at risk are given in brackets

sixteen born at home. Almost certainly this group should also contain some subjects which died soon after birth and were not identified. We conclude that first-born mongols are inadequately represented in the domiciliary group because mortality is high immediately after birth, and they die unrecognized. The hospital series, therefore, gives a more acceptable estimate of the effect of birth rank. It is concluded that, although the estimate given in Table VI may not be accurate, the finding that primogeniture is significant in the aetiology of mongolism may nevertheless be accepted.

A further point of interest shown in Table VIII is that the relationship between mortality and birth rank is reversed after the first fortnight of life. This is, of course, consistent with the view that mongols often die from infections, of which the risk increases with birth rank. It is probable that the same relationship is maintained throughout childhood, and it may more than offset the relatively disadvantageous position of first-born mongols at birth and for a short time afterwards.

DISCUSSION

The aetiological importance of maternal age in mongolism is so marked that it may be demonstrated by crude methods. The influence of primogeniture is much less obvious, and can probably be established only in series identified at birth. It is unlikely to be exhibited in cases diagnosed in the later months of the first year, and ascertainment in later childhood may lead to a spurious result because first-born infants are less exposed to infection and, if they survive the neonatal period, are less likely to die than later born. It seems probable that the small primogeniture effect noted by Penrose (1934) can be explained in this way. By ascertaining cases at or shortly after birth it is possible to eliminate this source of error.

The present investigation differs from that of Penrose in another respect. His technique was based on the Greenwood-Yule method, which depends on a comparison between affected and unaffected members of the same sibship. Penrose (1954) has pointed out that this method may give a false result if the birth of an affected child deters the parents from further reproduction. Although there is little evidence to support it, Southwick (1939) considered this possibility to be likely in families containing a mongol. In any case, the difficulty does not arise if a control group representative of all births is used. This method, however, has been criticized by Penrose (1954) on the grounds that "errors could be introduced if mothers of affected infants possessed some peculiarity not shared by the control mothers. For example, they might be disposed by constitution to produce children at relatively late ages".

In our view this possibility enhances rather than detracts from the value of the control group method. The discovery of a birth rank or maternal age effect serves little purpose unless it is followed by an exploration of its possible causes. The investigation of fertility is an obvious first step; for this purpose the use of a properly constituted control group is essential.

We consider that, although the use of the Greenwood-Yule method is attractive in that it avoids the labour of assembling a series of controls, it is less informative and more open to error than the alternative method. The control group method has the further advantage that it makes possible an examination of the fertility of the mothers of affected children. It is proposed to deal with this aspect of the problem in a subsequent communication.

SUMMARY

(1) The association between the incidence of mongolism and maternal age and birth rank is examined by comparing a series of 217 mongols born in Birmingham in the years 1942–52 with 1,156 infants representative of all births in the city in the same period.

(2) The well-known relationship between incidence and maternal age is shown to be little affected by eliminating the influence of birth rank.

(3) Incidence increases regularly with increasing birth rank. When maternal age is fixed this association is eliminated, and incidence is greater in first-born than in later born infants at all maternal ages except "40 and over".

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